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**Goodwin et al.**

(10) **Patent No.: US 9,314,751 B2**
(45) **Date of Patent: Apr. 19, 2016**

(54) **METHODS AND APPARATUS FOR MIXING AND SHIPPING FLUIDS**

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(73) Assignee: **Life Technologies Corporation**, Carlsbad, CA (US)

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(22) Filed: **Jan. 7, 2011**

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US 2012/0175012 A1 Jul. 12, 2012

(51) **Int. Cl.**

| | |
|---|---|
| ***B01F 7/00*** | (2006.01) |
| ***B01F 7/16*** | (2006.01) |
| ***B01F 3/04*** | (2006.01) |
| ***B01F 7/22*** | (2006.01) |
| ***B01F 13/00*** | (2006.01) |

(Continued)

(52) **U.S. Cl.**

CPC ..... ***B01F 7/1695*** (2013.01); ***B01F 3/04262*** (2013.01); ***B01F 3/04269*** (2013.01); ***B01F 3/04531*** (2013.01); ***B01F 7/00691*** (2013.01); ***B01F 7/00725*** (2013.01); ***B01F 7/22*** (2013.01); ***B01F 13/0032*** (2013.01); ***B01F 15/00006*** (2013.01); ***B01F 15/0072*** (2013.01); ***B01F 15/0085*** (2013.01); ***B01F 15/00785*** (2013.01); ***C12M 23/26*** (2013.01); ***C12M 27/02*** (2013.01); ***C12M 29/06*** (2013.01); *B01F 7/00* (2013.01); *B01F 7/00033* (2013.01); *B01F 7/00208* (2013.01); *B01F 2215/0431* (2013.01); *B65B 3/045* (2013.01)

(58) **Field of Classification Search**

USPC ..... 56/467, 469, 428, 111 R, 170, 175, 449; 53/467, 469, 428, 111 R, 170, 175, 449

See application file for complete search history.

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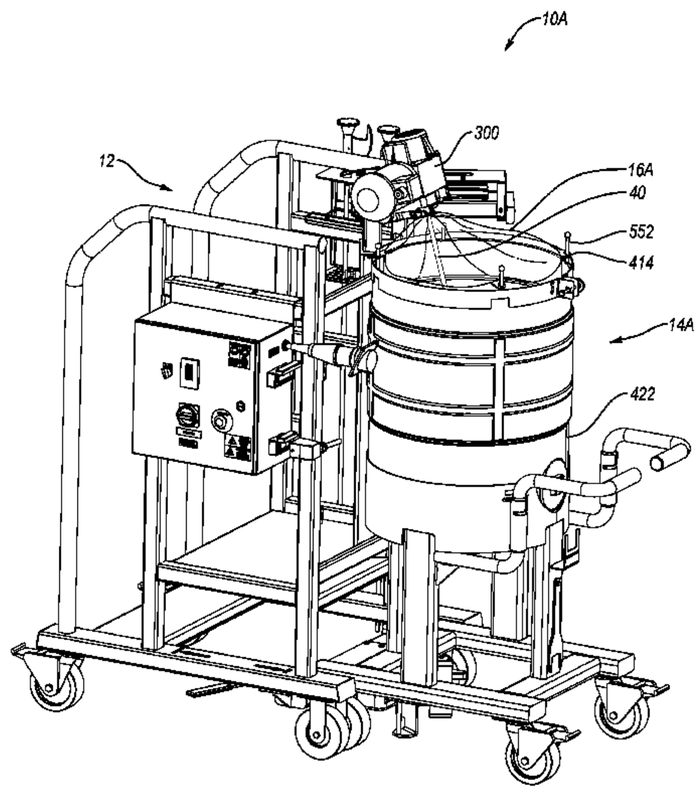
*Primary Examiner* — Christopher Harmon

(74) *Attorney, Agent, or Firm* — Workman Nydegger

(57) **ABSTRACT**

A method for mixing includes releasably coupling a first container station to a docking station, the first container station having a shipping vessel bounding a compartment, the docking station having a stand and a drive motor assembly adjustably mounted to the stand. The vertical or horizontal position of the drive motor assembly is adjusted relative to the stand so that the drive motor assembly is in a first position. A drive shaft is advanced through the drive motor assembly and into a chamber of a first collapsible bag disposed within the compartment of the shipping vessel. The drive motor assembly is activated so that the mixer rotates the drive shaft causing mixing of the fluid within the first collapsible bag.

**21 Claims, 23 Drawing Sheets**



(51) **Int. Cl.**

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| ***B01F 15/00*** | (2006.01) |
| ***C12M 1/00*** | (2006.01) |
| ***C12M 1/06*** | (2006.01) |
| *B65B 3/04* | (2006.01) |

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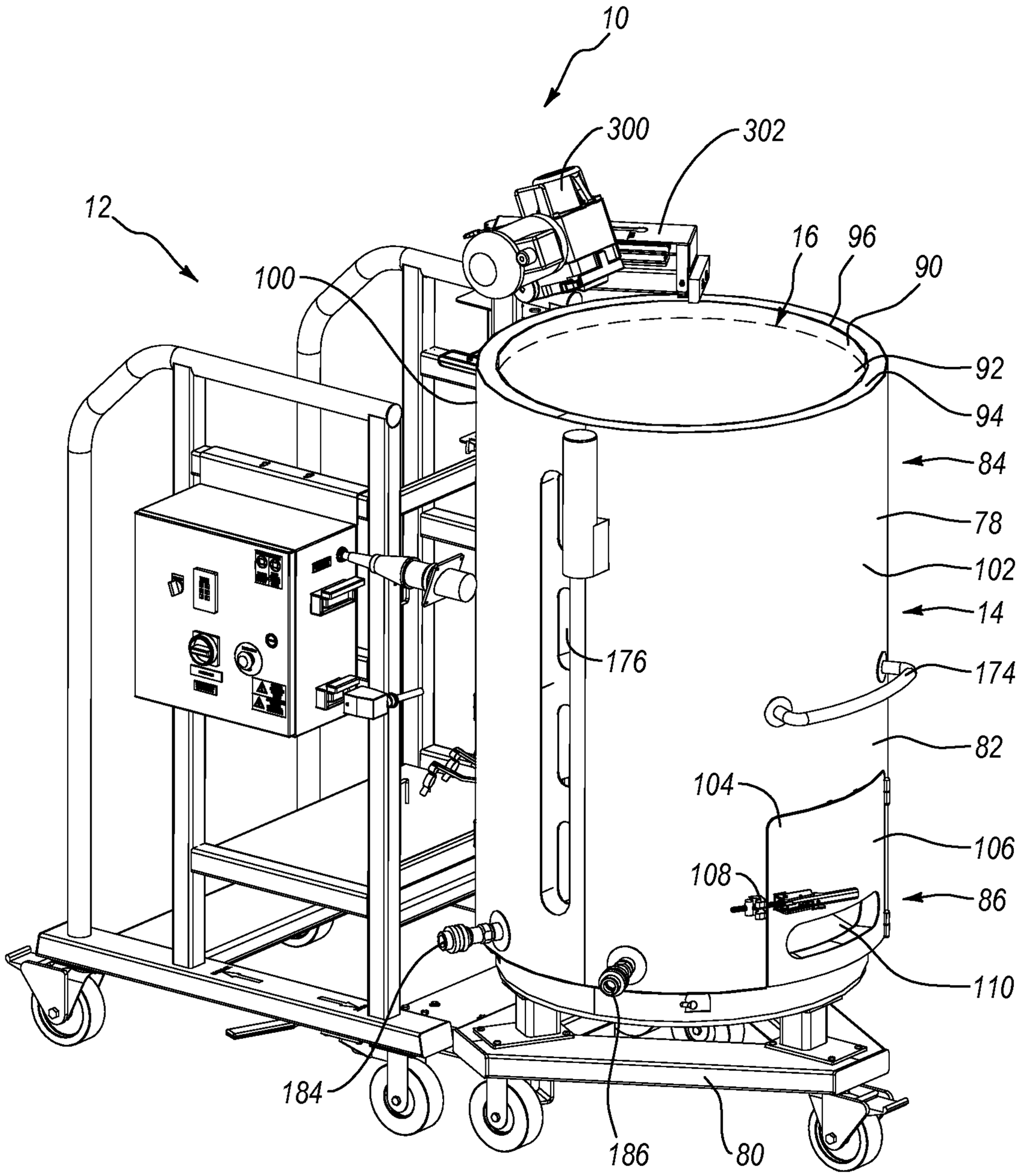
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Fig. 1

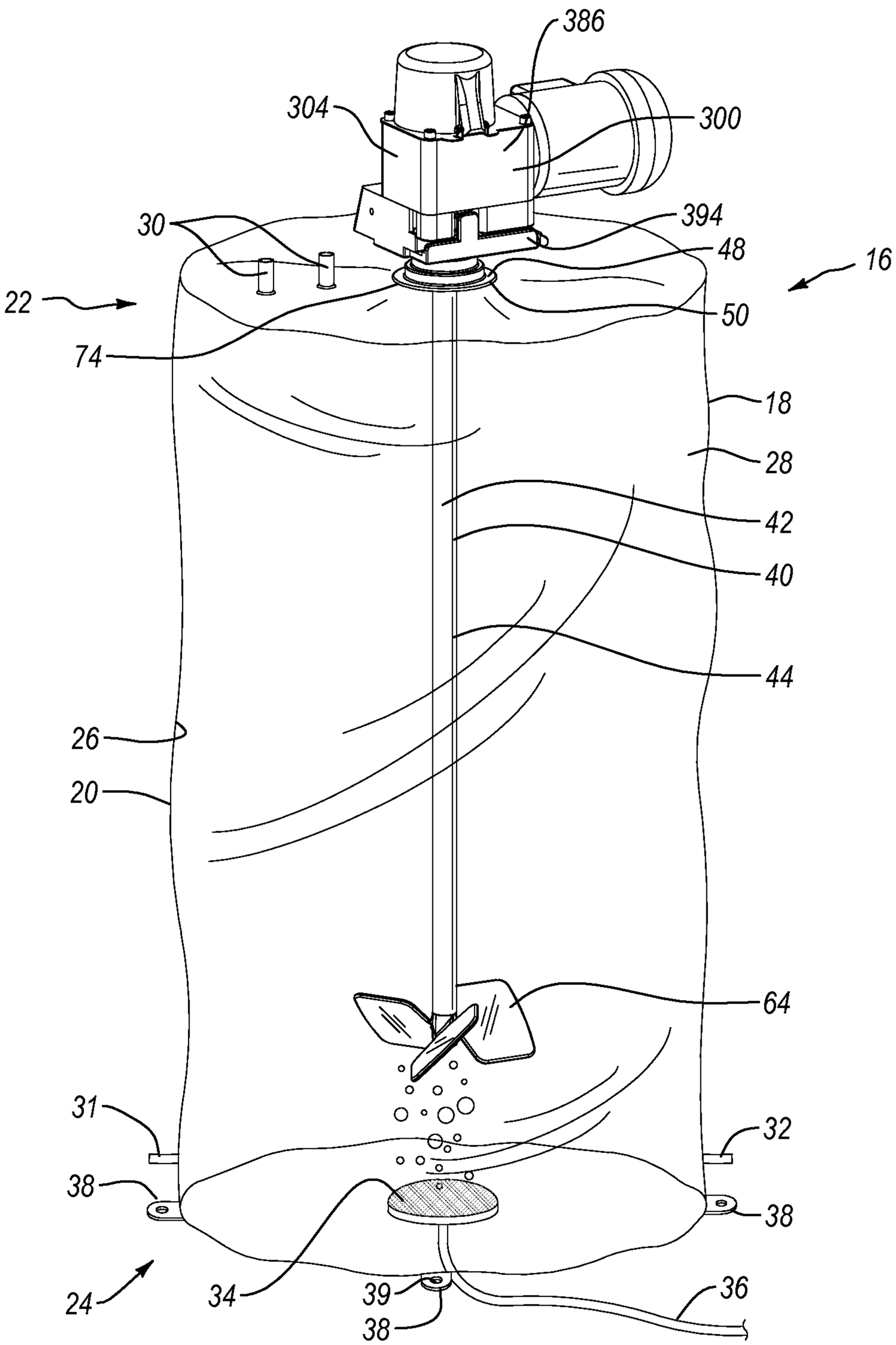
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Fig. 2

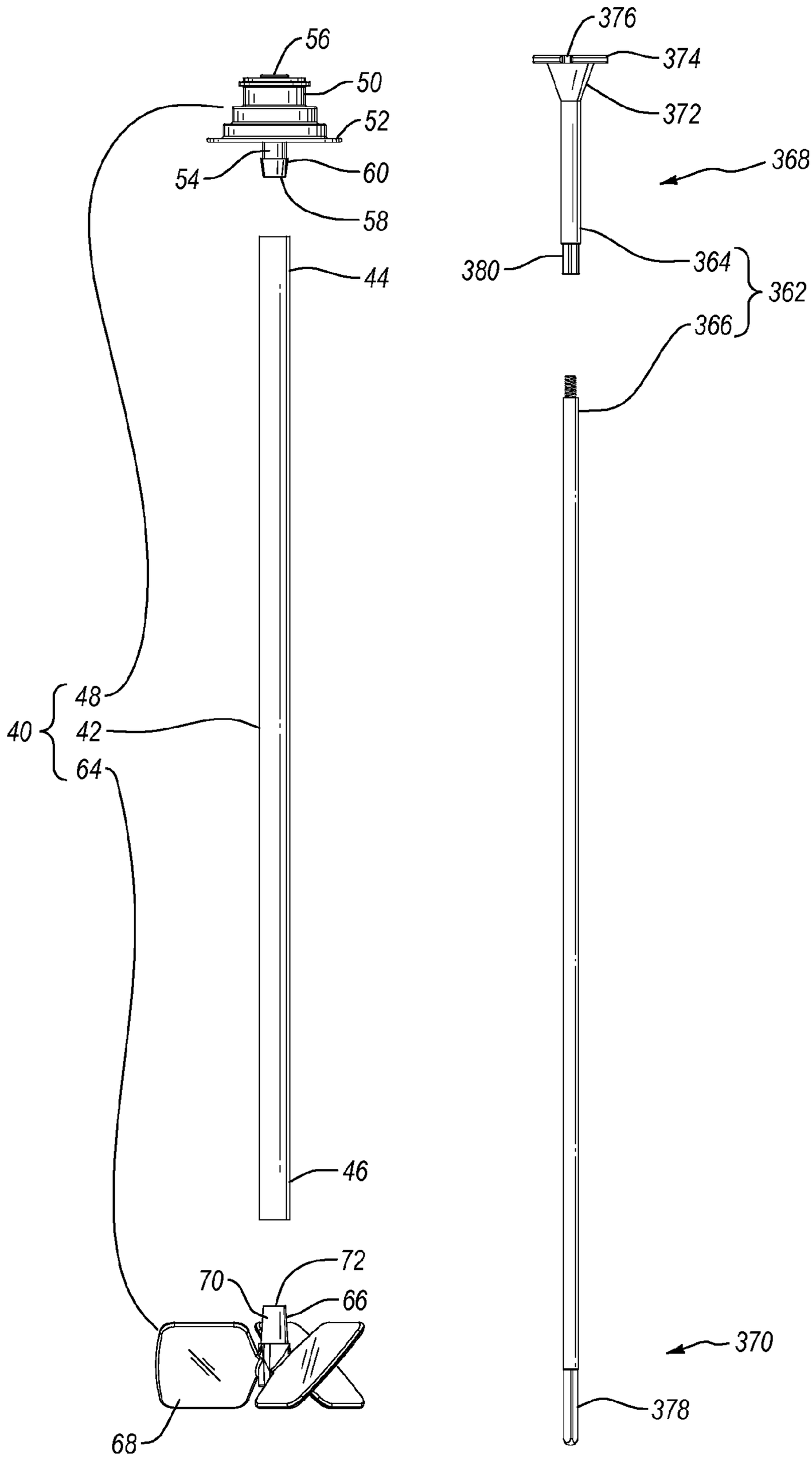
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*Fig. 3*

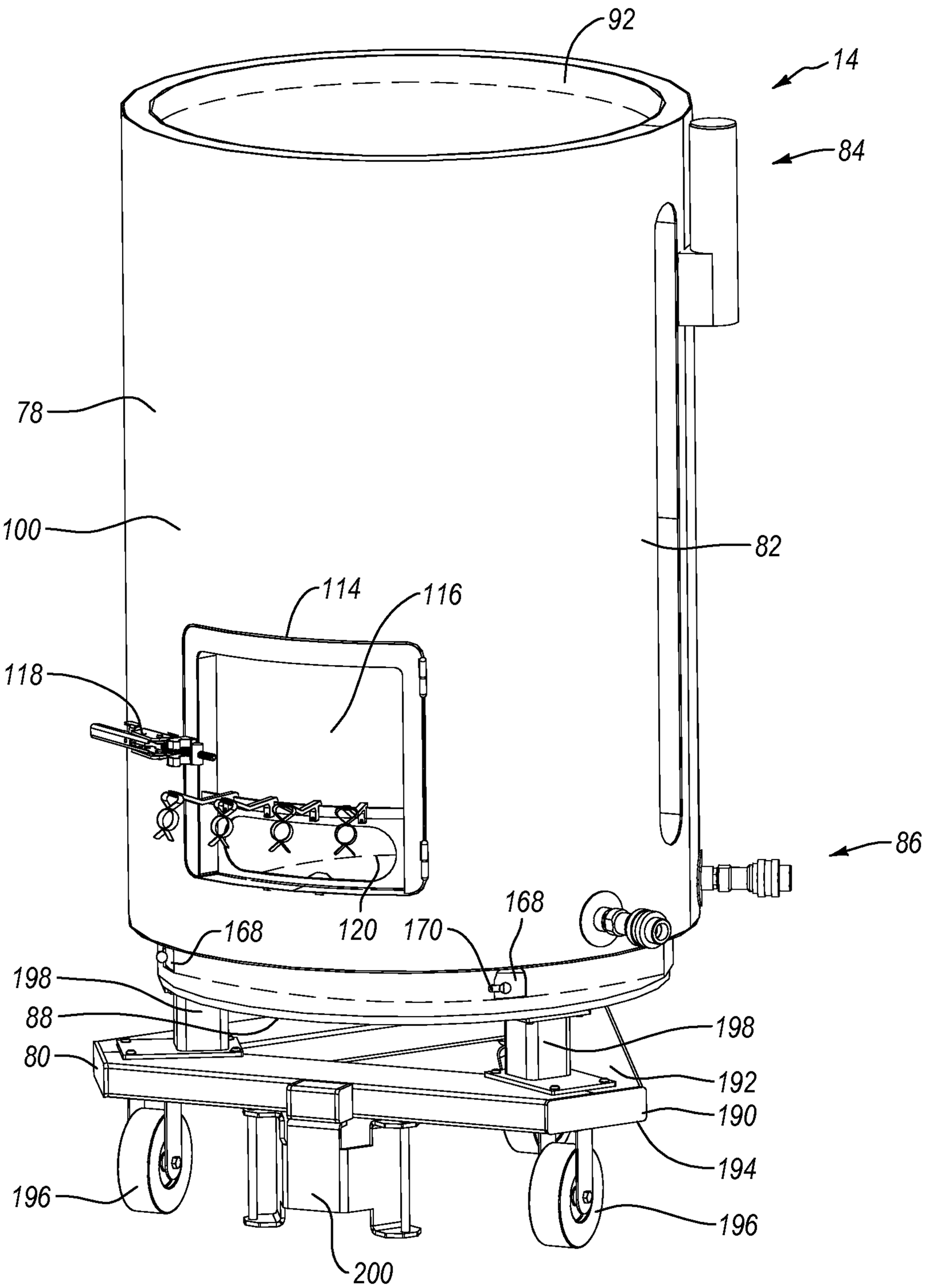
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Fig. 4

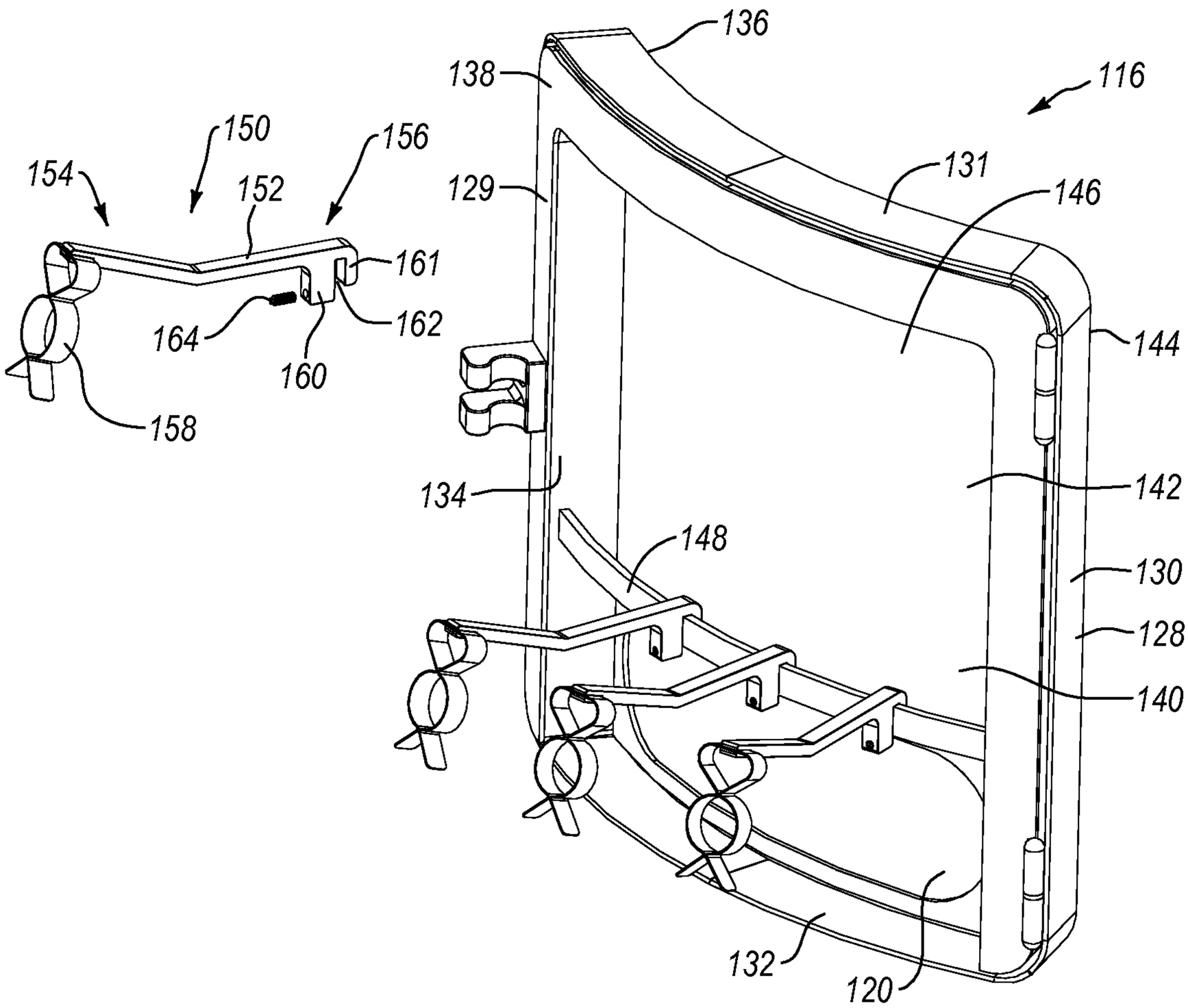
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*Fig. 5*

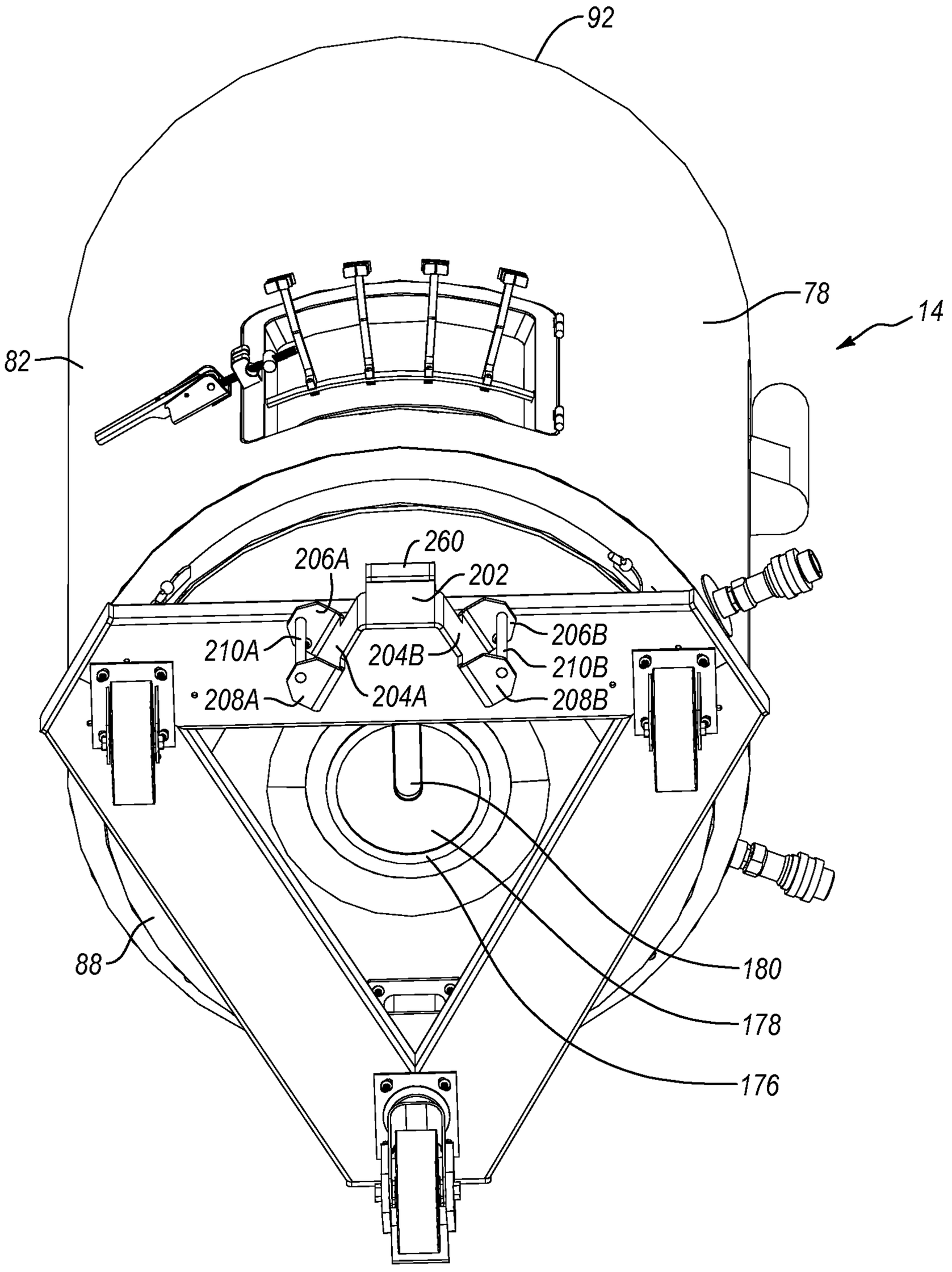
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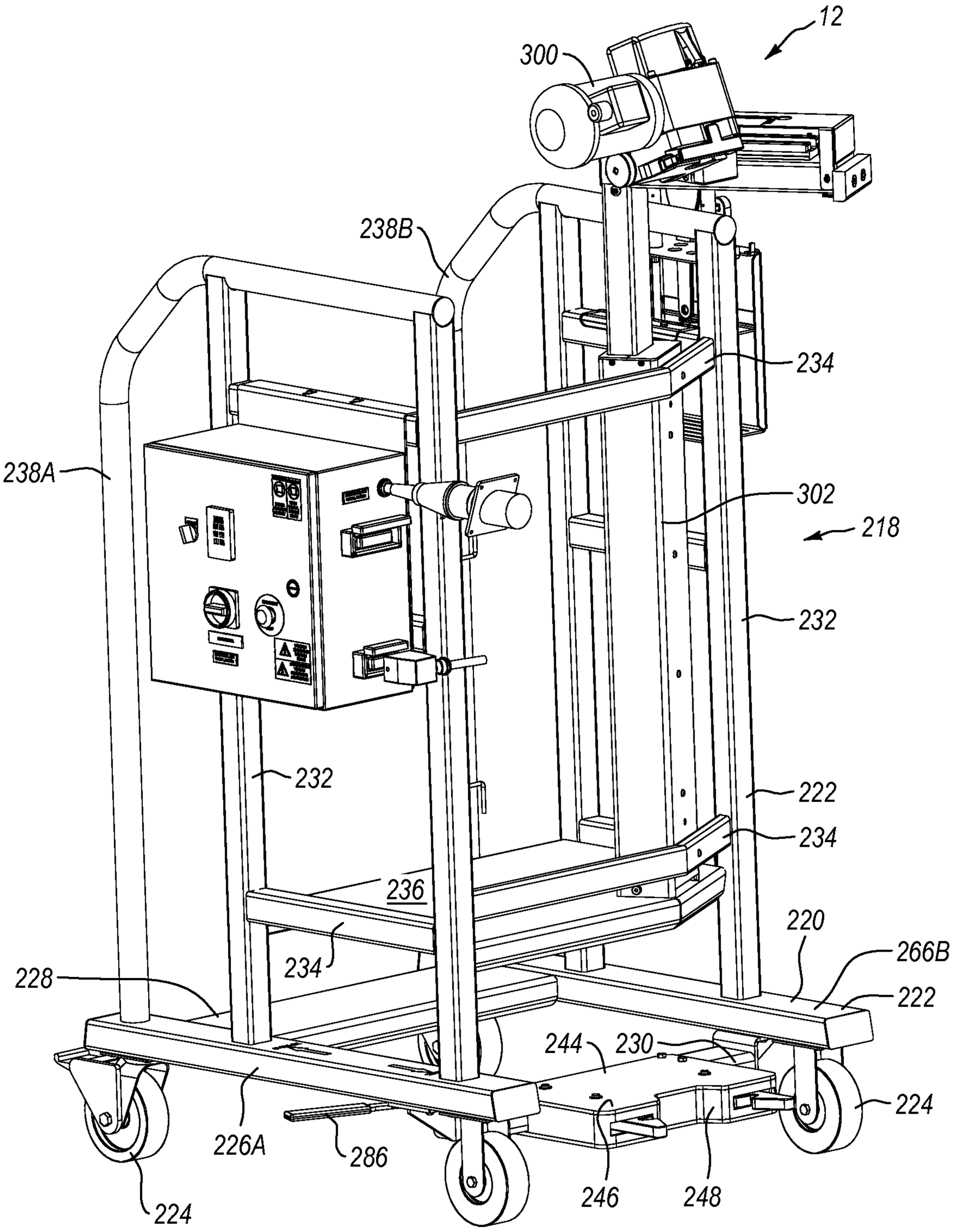
*Fig. 6*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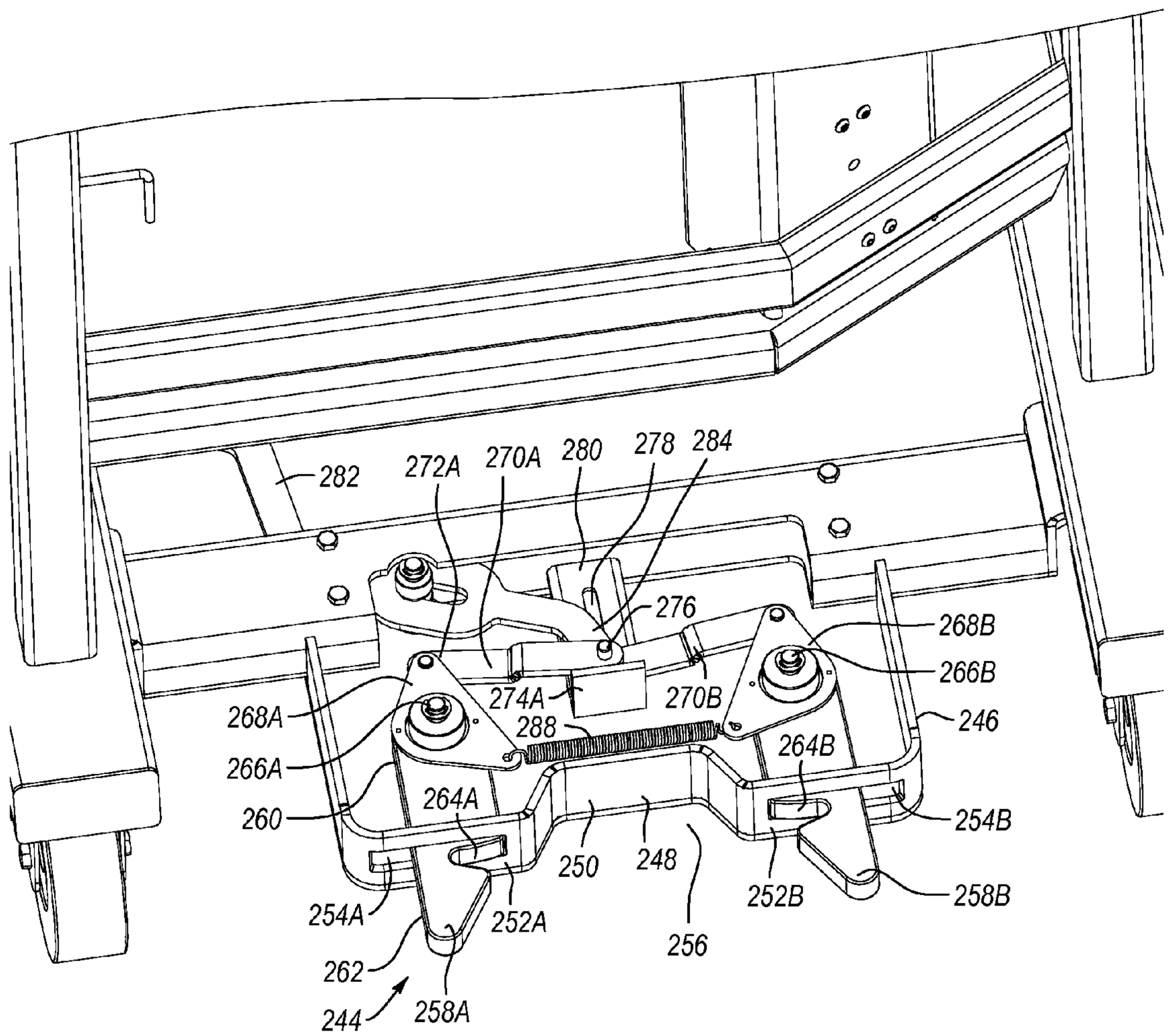
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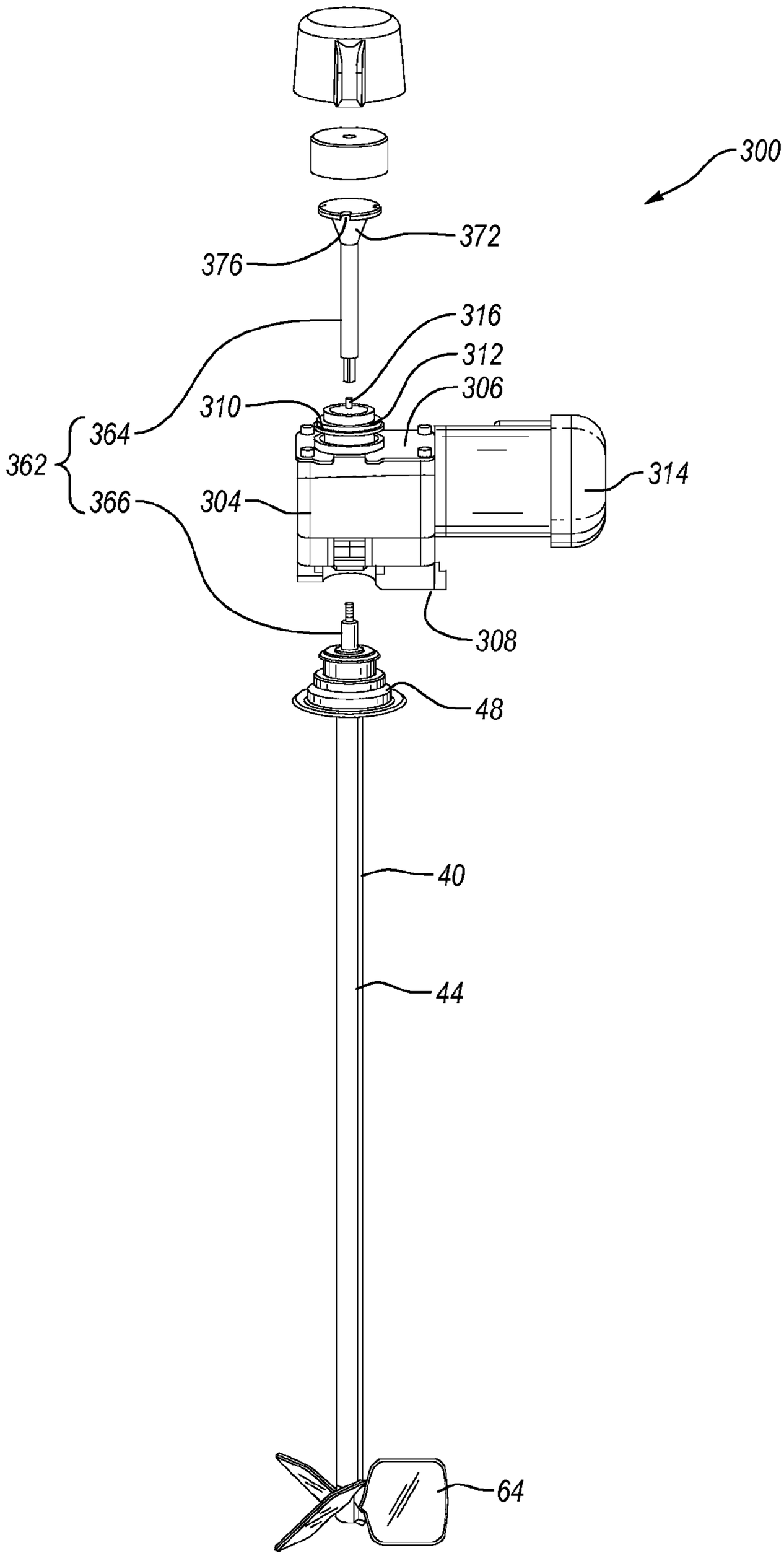
*Fig. 8*

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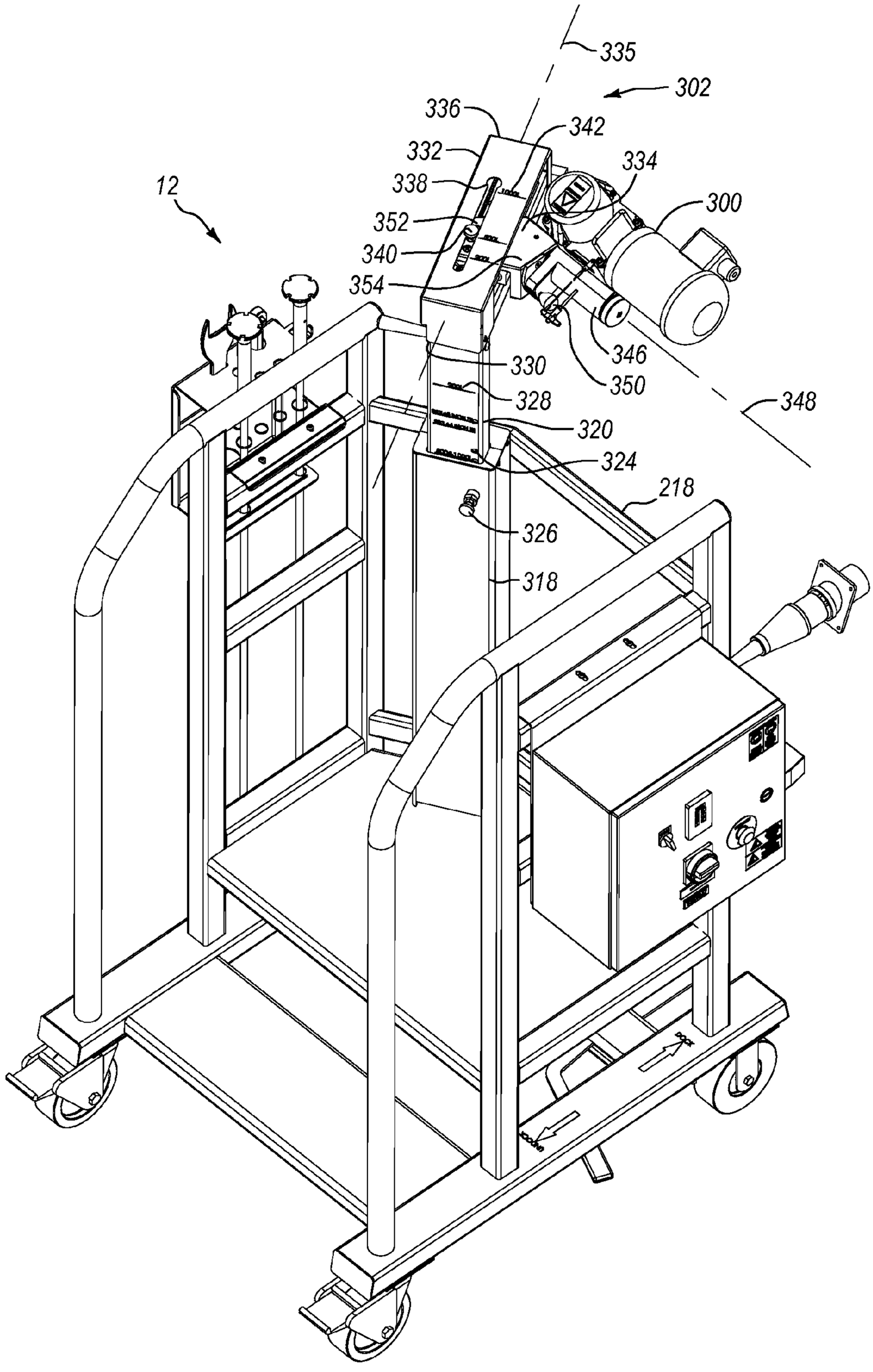
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*Fig. 10*

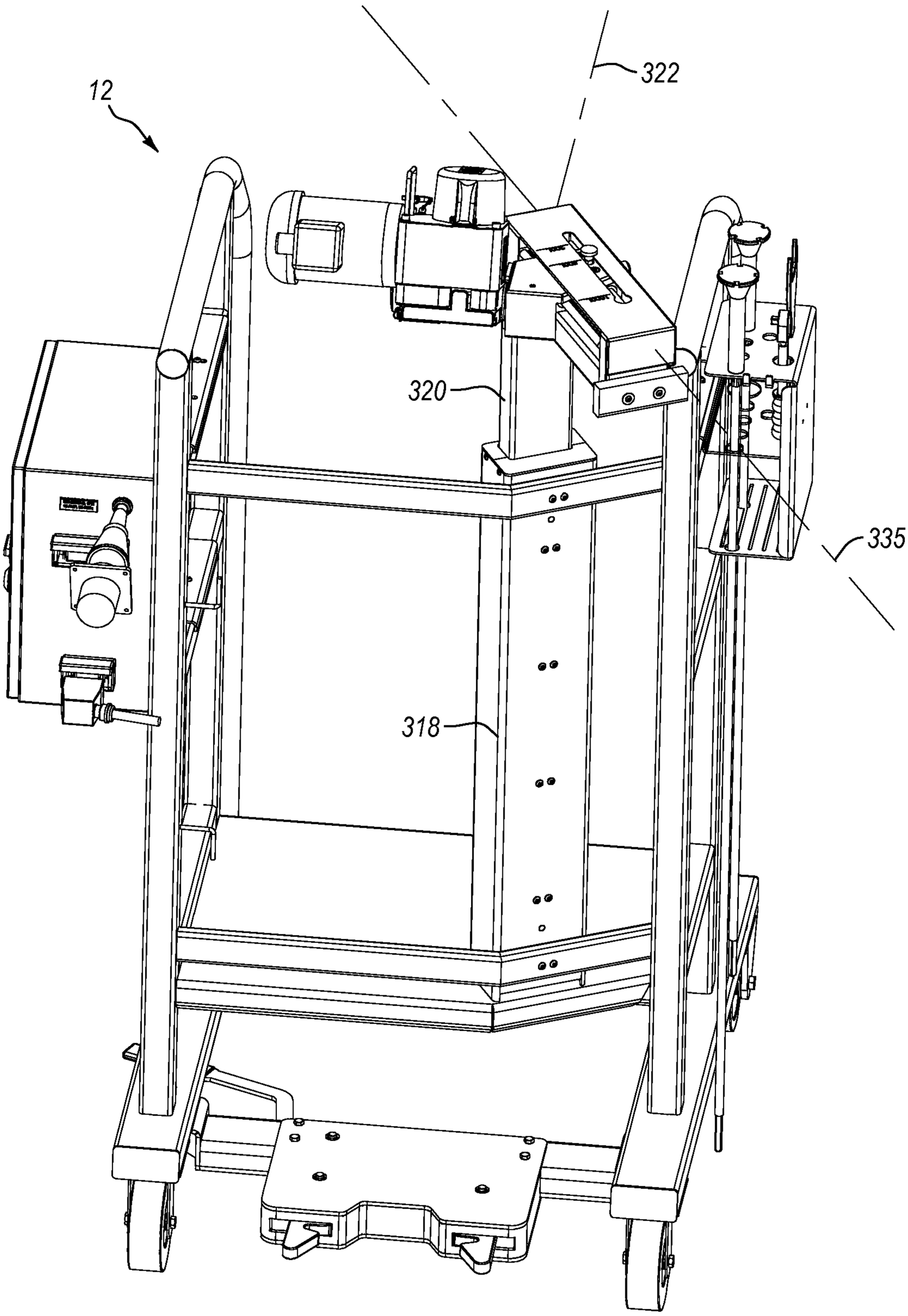
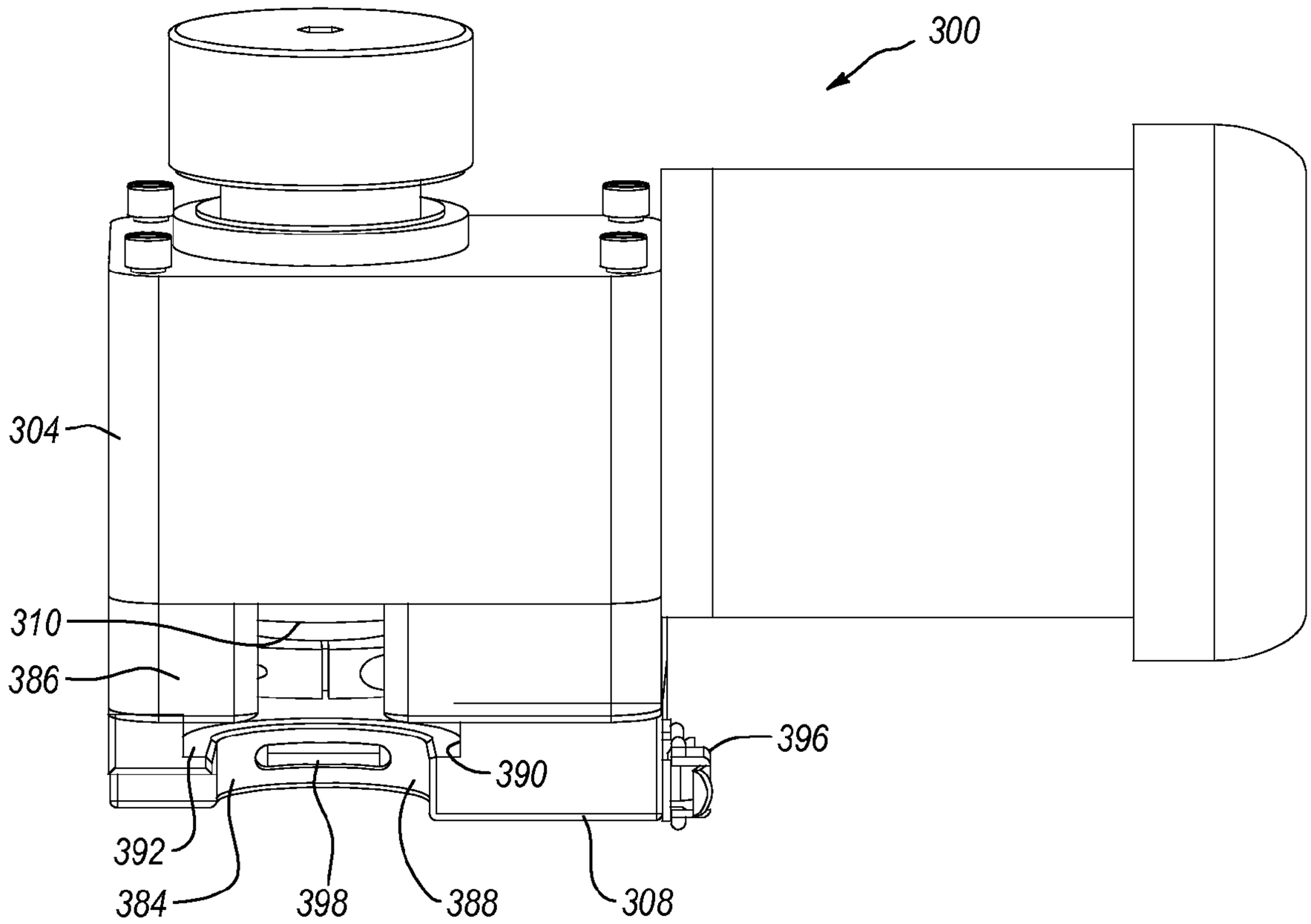
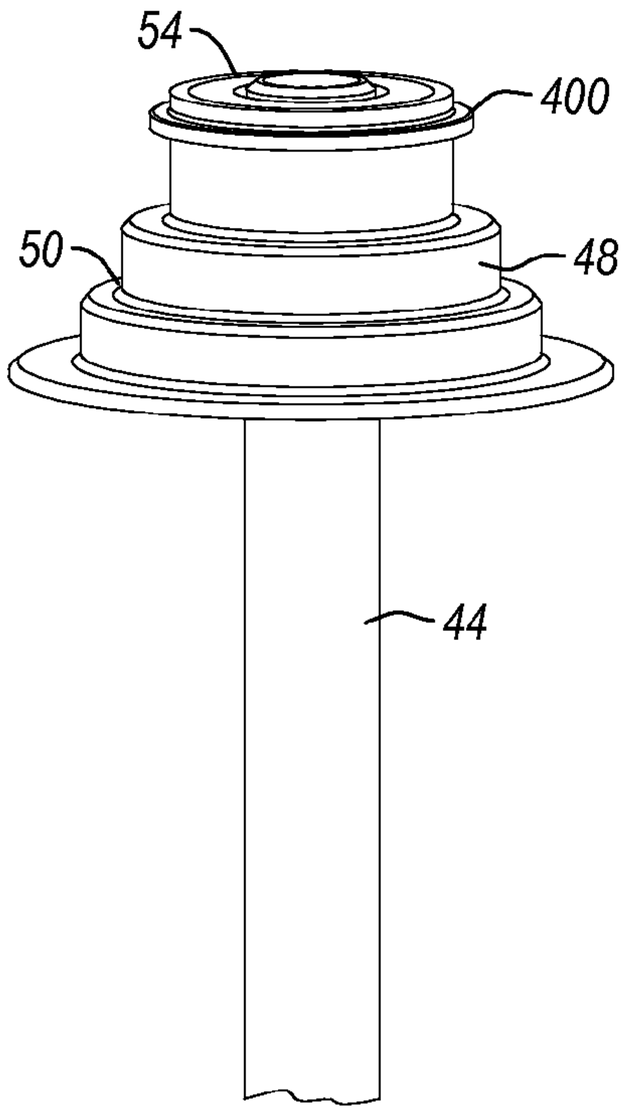



*Fig. 11*

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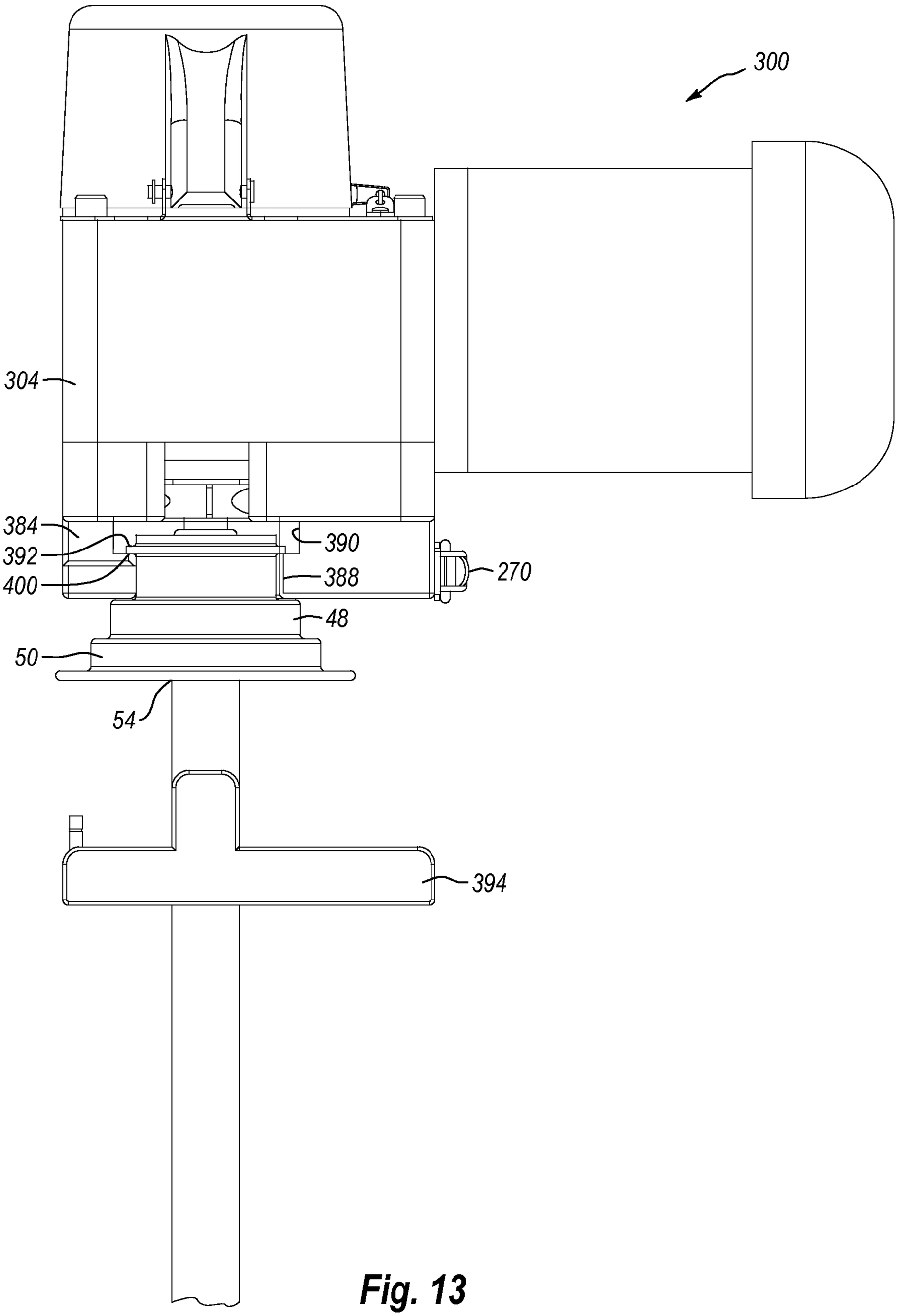


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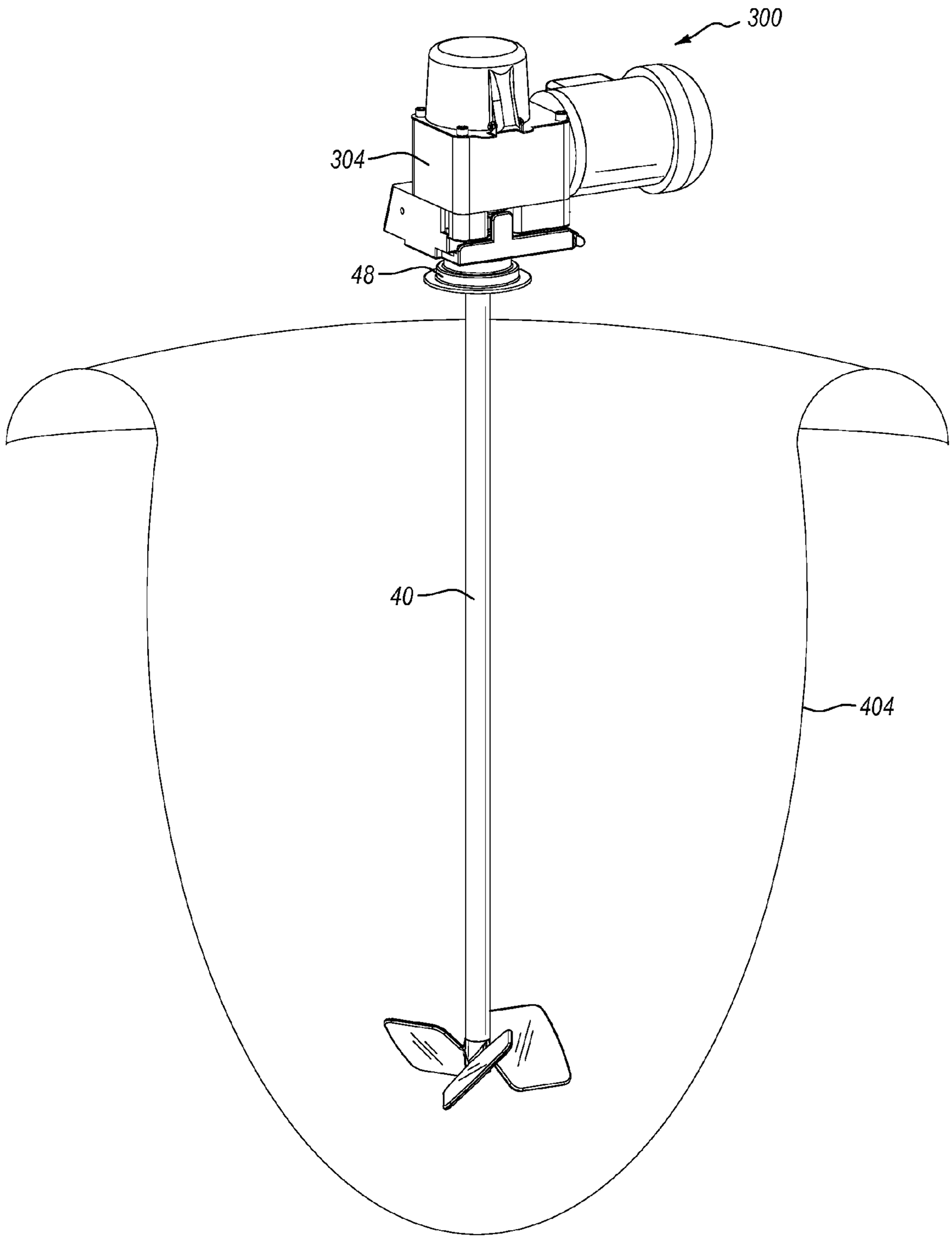



*Fig. 14*

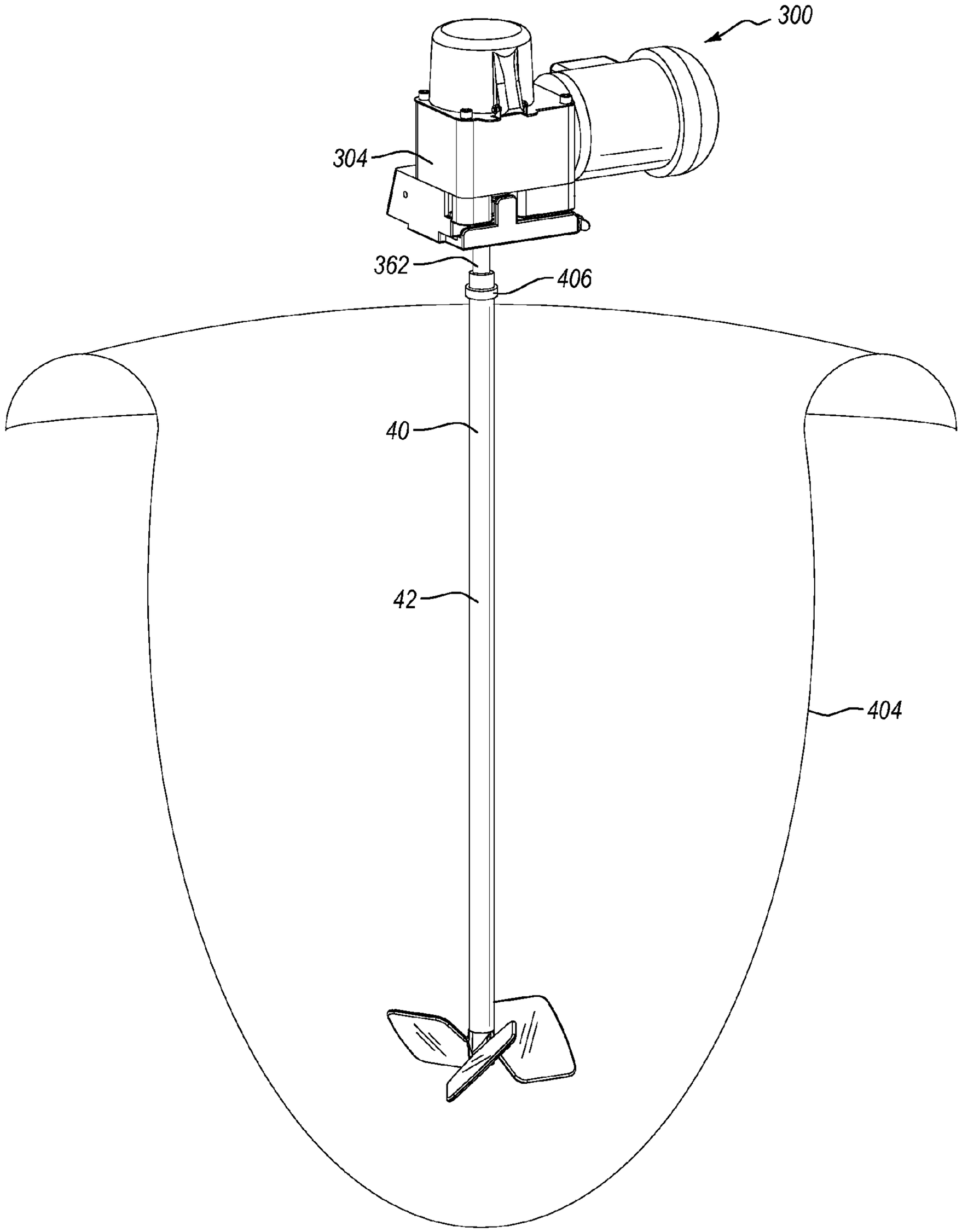
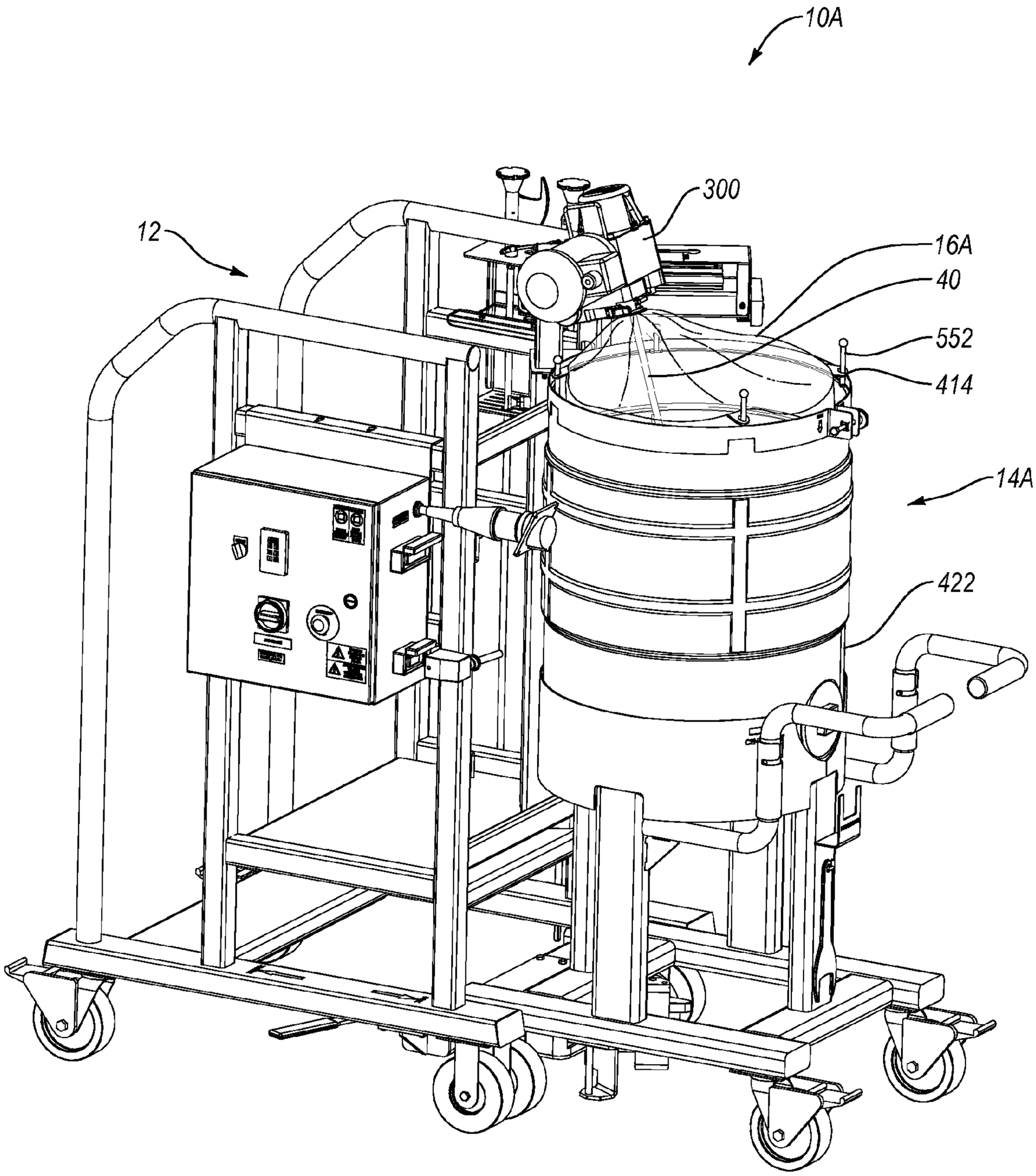



*Fig. 15*

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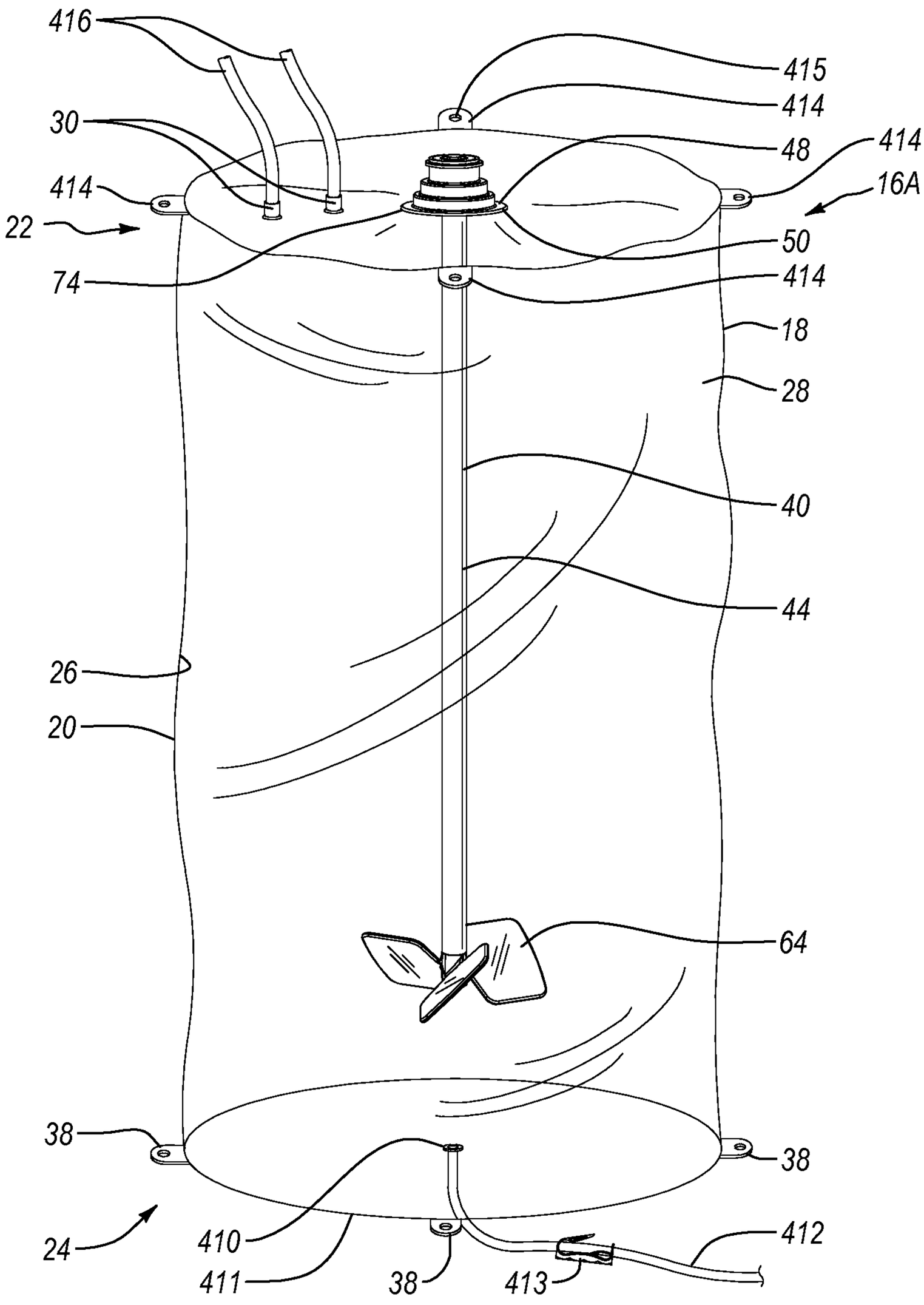
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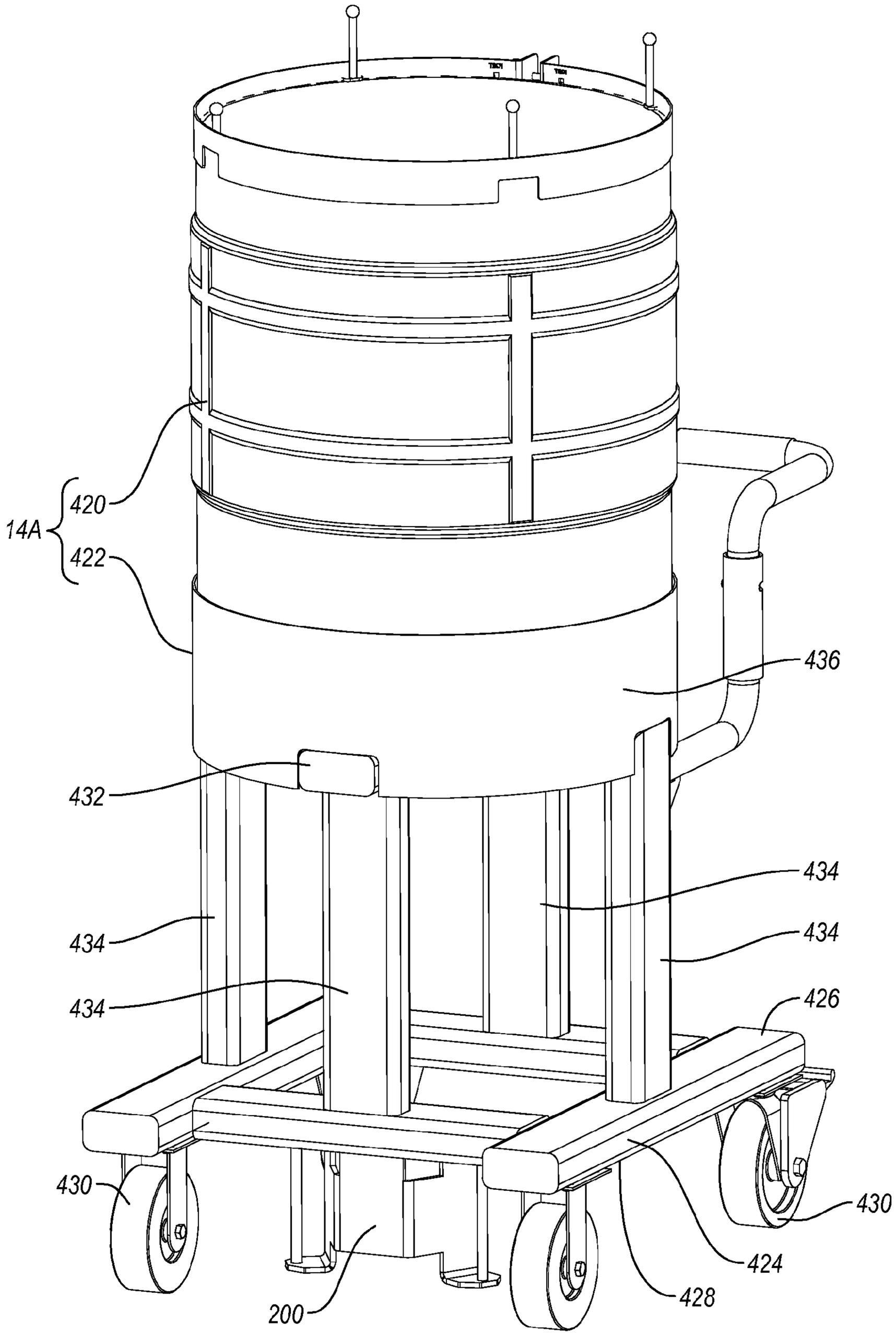
Fig. 17

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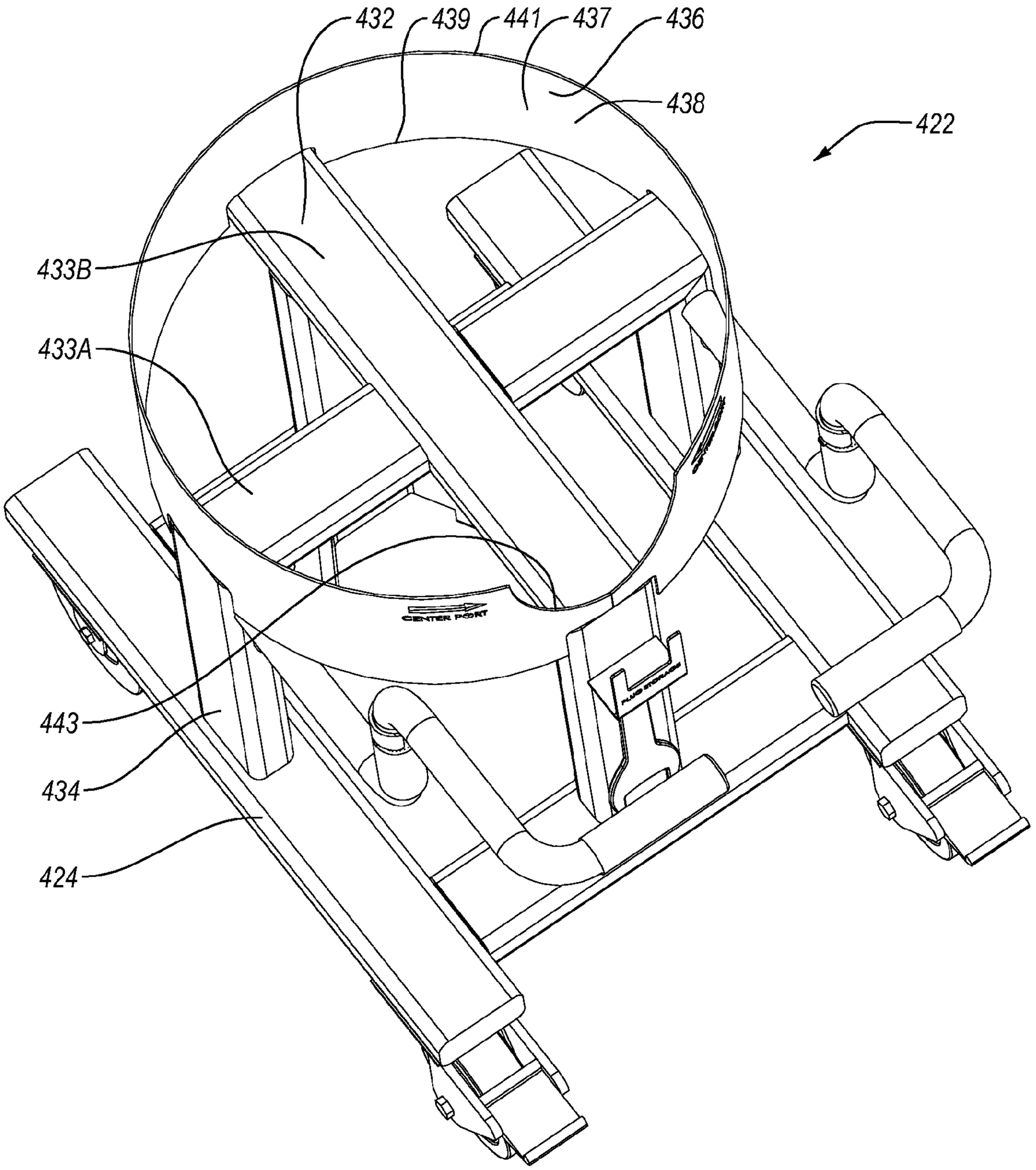
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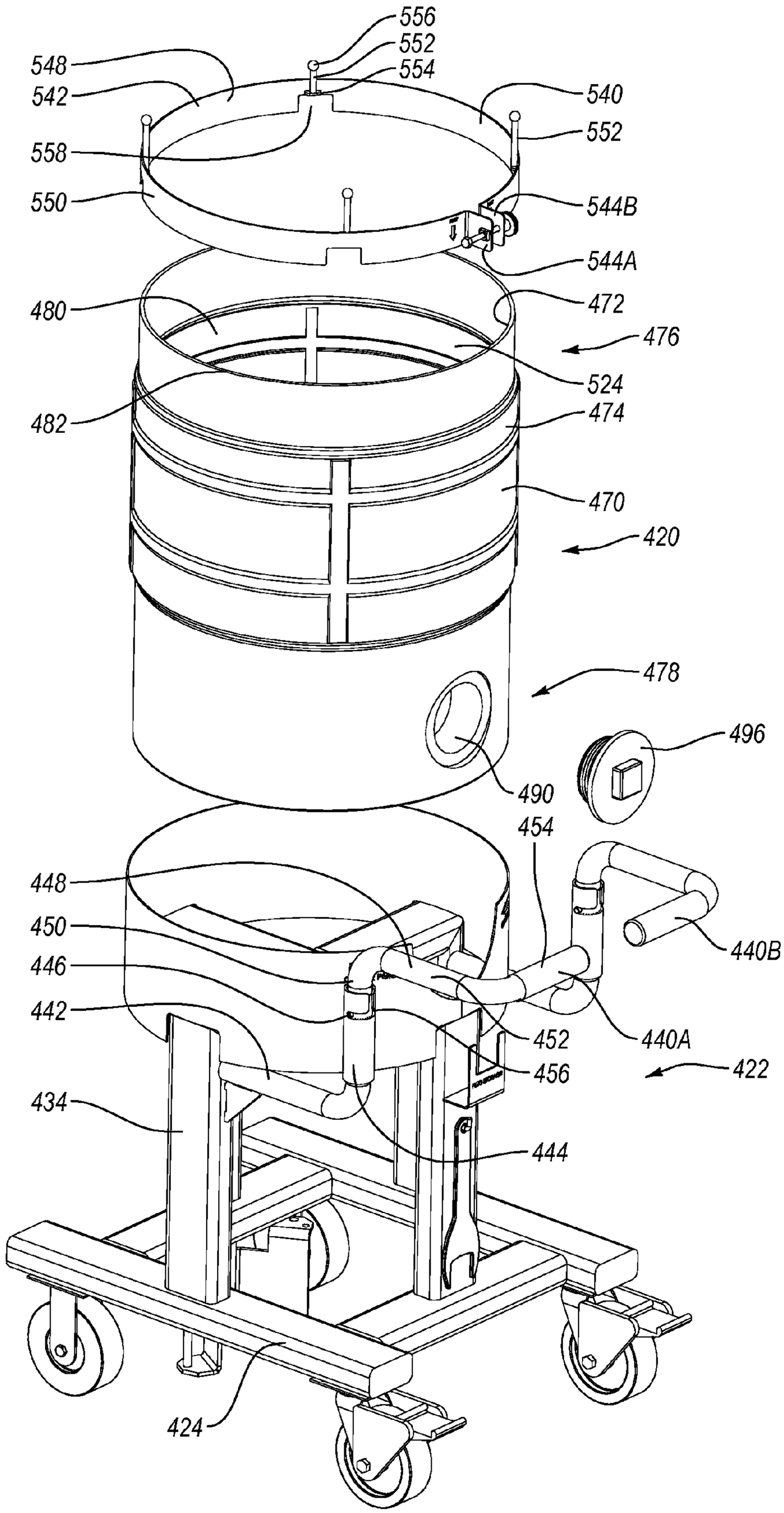
CENTER PORT
PLUG STORAGE

*Fig. 19*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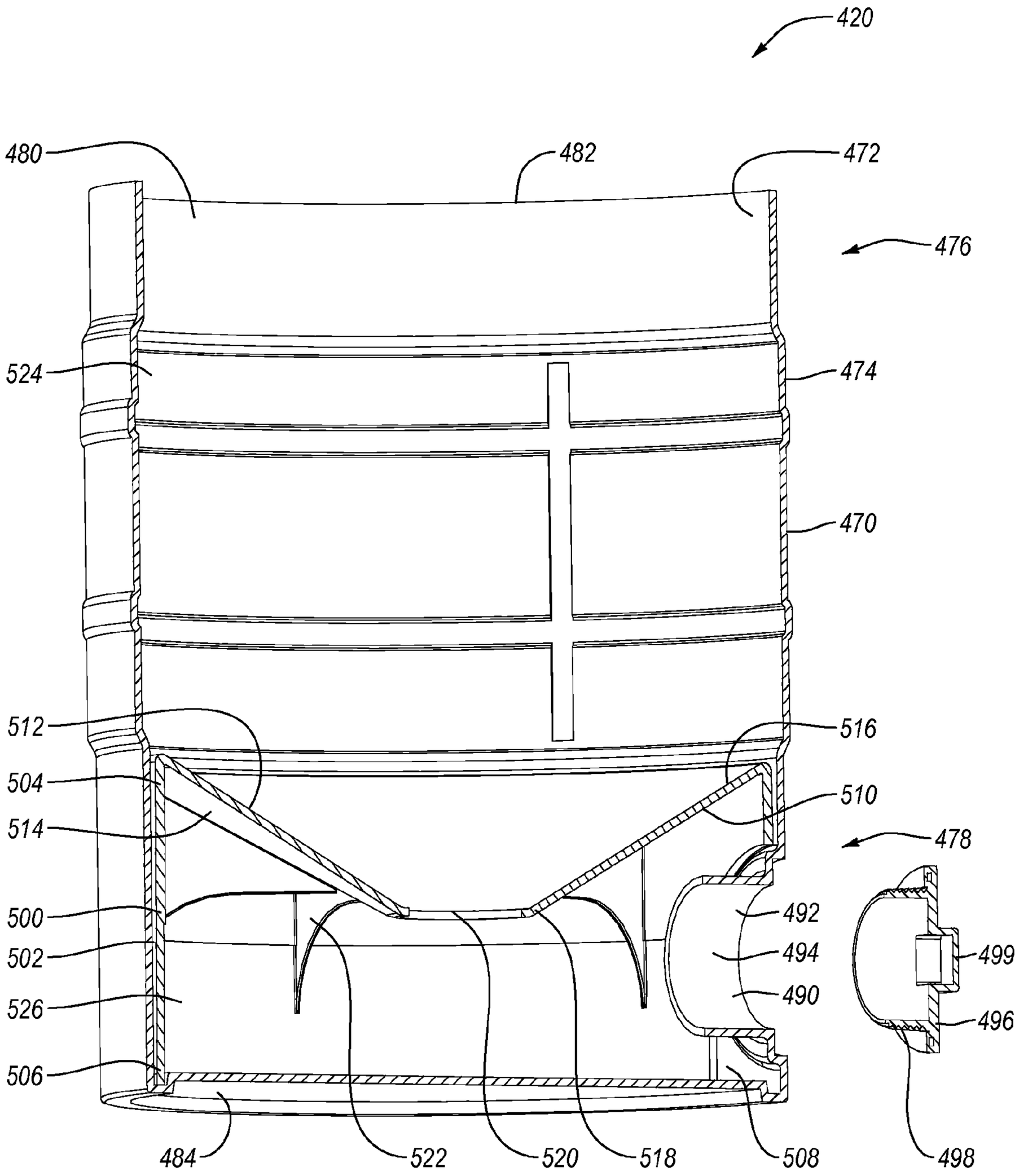
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Fig. 21

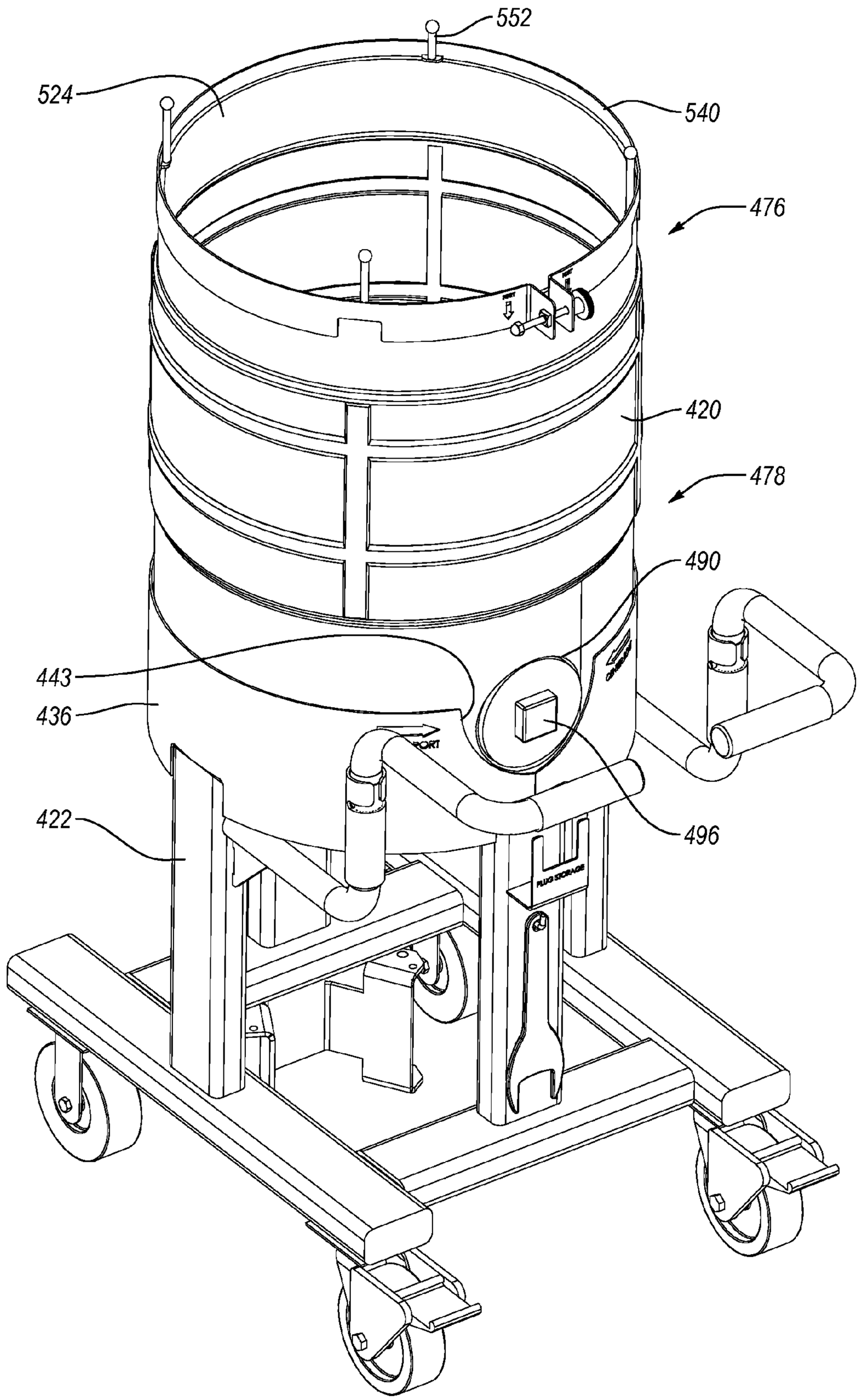


Fig. 22

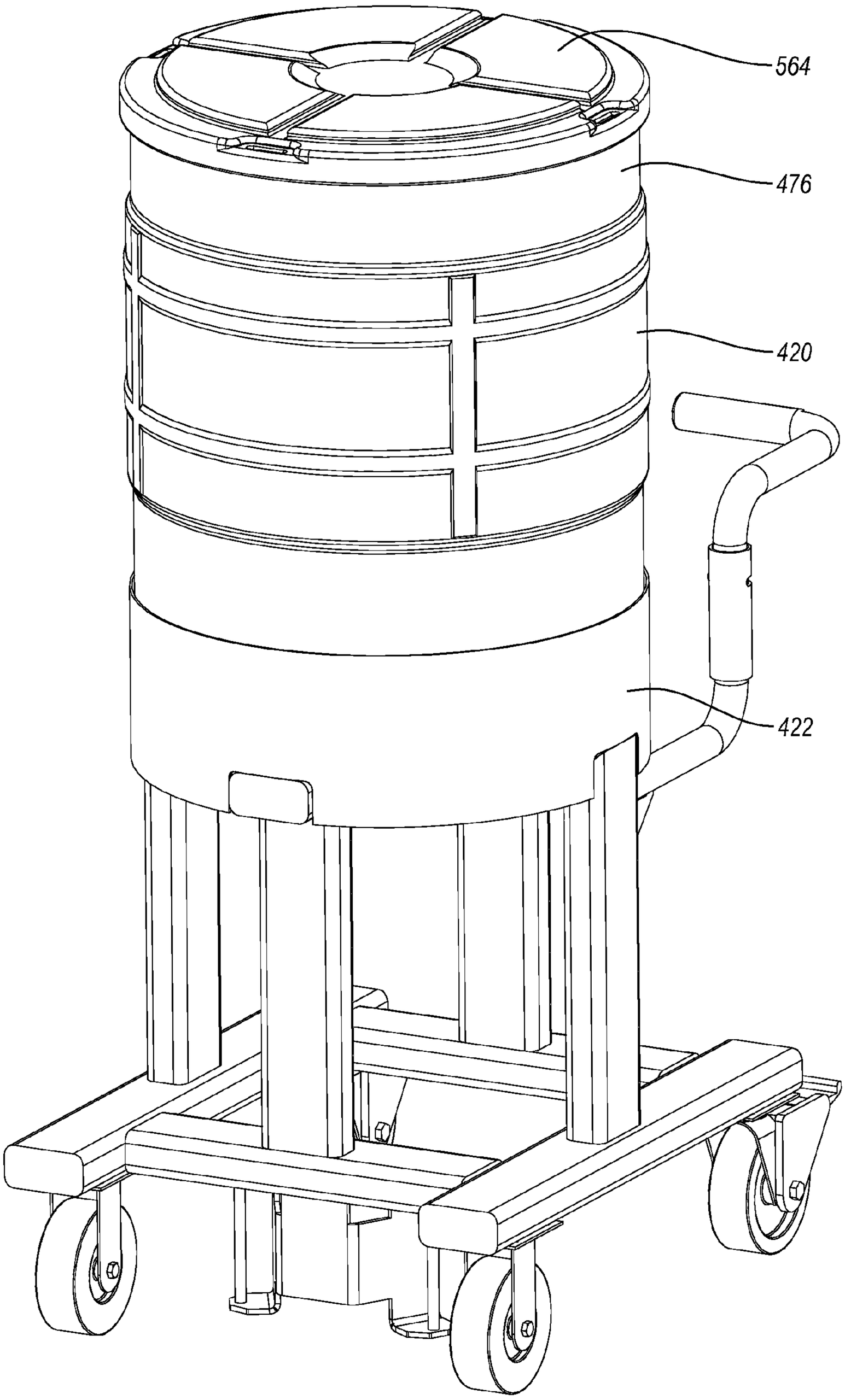


*Fig. 23*

# METHODS AND APPARATUS FOR MIXING AND SHIPPING FLUIDS

## CROSS-REFERENCE TO RELATED APPLICATIONS

Not applicable.

## BACKGROUND OF THE INVENTION

1. The Field of the Invention

The present invention relates to methods and systems for mixing and shipping fluids, namely, biological fluids.

2. The Relevant Technology

The biopharmaceutical industry uses a broad range of mixing systems for a variety of processes such as in the preparation of media and buffers and in the growing of cells and microorganisms in bioreactors. Many conventional mixing systems, including bioreactors, comprise a rigid tank that can be sealed closed. A drive shaft with impeller is rotatably disposed within the tank. The impeller functions to suspend and mix the components.

In many cases, great care must be taken to sterilize and maintain the sterility of the mixing system so that the culture or other product does not become contaminated. Accordingly, between the production of different batches, the mixing tank, mixer, and all other reusable components that contact the processed material must be carefully cleaned to avoid any cross contamination. The cleaning of the structural components is labor intensive, time consuming, and costly. For example, the cleaning can require the use of chemical cleaners such as sodium hydroxide and may require steam sterilization as well. The use of chemical cleaners has the additional challenge of being relatively dangerous, and cleaning agents can be difficult and/or expensive to dispose of once used.

Furthermore, biological fluids are often produced in bulk at a manufacturing facility and then shipped in smaller quantities to customers for further processing or utilization. This process typically entails manufacturing a fluid through use of a mixing process, dispending the fluid into a transport container, and then shipping the transport container to a customer. The customer then dispenses the fluid into a further processing container so that the fluid can be remixed or resuspended so that the fluid is homogeneous prior to use. As can be appreciated, this transferring of fluids between different containers can be time consuming, labor intensive and run the risk of breaching sterility.

Accordingly, what is needed are mixing systems that require minimum cleaning or sterilization. What is also needed are systems that that can be used for preparing, transporting, and resuspending solutions that are simple to use and minimize in risk of breaching sterility.

## BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of the present invention will now be discussed with reference to the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope.

FIG. **1** is a perspective view of a container station docked with a docking station;

FIG. **2** is a perspective view of a container assembly that is used with the container station shown in FIG. **1**;



FIG. **3** is an elevated side view of an impeller assembly forming part of the container assembly shown in FIG. **2** and a drive shaft;

FIG. **4** is a front perspective view of the container station shown in FIG. **1**;

FIG. **5** is a perspective view of a door of the container station shown in FIG. **4**;

FIG. **6** is a is a bottom perspective view of the container station shown in FIG. **4**;

FIG. **7** is a front perspective view of the docking station shown in FIG. **1**;

FIG. **8** is a top perspective view of the locking assembly shown in FIG. **7**;

FIG. **9** is a partially disassembly perspective view of a drive motor assembly of the docking station shown in FIG. **7** in association with the impeller assembly and drive shaft;

FIG. **10** is a top perspective view of the docking station shown in FIG. **7**;

FIG. **11** is an alternative perspective view of the docking station shown in FIG. **7**;

FIG. **12** is a front perspective view of the drive motor assembly and rotational assembly;

FIG. **13** is an elevated front view of the rotational assembly shown in FIG. **12** coupled with the drive motor assembly;

FIG. **14** is a perspective view of an alternative embodiment of a container being used with a drive motor assembly and impeller assembly;

FIG. **15** is a perspective view of an alternative embodiment of the impeller assembly shown in FIG. **14**.

FIG. **16** is a perspective view of one embodiment of a mixing system incorporating features of the present invention;

FIG. **17** is a perspective view of one embodiment of a container assembly that can be used in the mixing system shown in FIG. **16**;

FIG. **18** is a front perspective view of the container assembly shown in FIG. **16**;

FIG. **19** is a top perspective view of the cart of the container assembly shown in FIG. **18**;

FIG. **20** is a partially exploded perspective view of the container assembly shown in FIG. **18**;

FIG. **21** is a cross sectional side view of the shipping vessel of the container assembly shown in FIG. **18**;

FIG. **22** is rear perspective view of the container assembly shown in FIG. **18**; and

FIG. **23** is front perspective view of the container assembly shown in FIG. **18** having a lid mounted thereon.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to systems and methods for mixing and, if desired, sparging solutions and/or suspensions. The systems can be commonly used as bioreactors or fermenters for culturing cells or microorganisms. By way of example and not by limitation, the inventive systems can be used in culturing bacteria, fungi, algae, plant cells, animal cells, protozoans, nematodes, and the like. The systems can accommodate cells and microorganisms that are aerobic or anaerobic and are adherent or non-adherent. The systems can also be used in association with the formation and/or treatment of solutions and/or suspensions that are for biological purposes, such as media, buffers, or reagents. For example, the systems can be used in the formation of media where sparging is used to control the pH of the media through adjustment of the carbonate/bicarbonate levels with controlled gaseous levels of carbon dioxide. The systems can also

be used for mixing powders or other components into a liquid where sparging is not required and/or where is solution is not for biological purposes. In addition, alternative embodiments of the present invention can be used for initially mixing solutions, such as the above, followed by shipping and then remixing or suspending the solution once it has reached a desired destination.

The inventive systems are designed so that a majority of the system components that contact the material being processed can be disposed of after each use. As a result, the inventive systems substantially eliminate the burden of cleaning and sterilization required by conventional stainless steel mixing systems. This feature also ensures that sterility can be consistently maintained during repeated processing of multiple batches. The inventive systems are also adjustable so that they can be used for mixing a variety of different batch sizes. In view of the foregoing, and the fact that the inventive systems are easily scalable, relatively low cost, and easily operated, the inventive systems can be used in a variety of industrial and research facilities that previously outsourced such processing.

Depicted in FIG. **1** is one embodiment of an inventive system **10** incorporating features of the present invention. In general, system **10** comprises a docking station **12**, a container station **14** that removably docks with docketing station **12**, a container assembly **16** (FIG. **2**) that is supported by container station **14**, and a drive shaft **362** (FIG. **3**) that extends between docking station **12** and container assembly **16**. Container assembly **16** houses the solution or suspension that is mixed. The various components of system **10** will now be discussed in greater detail.

As depicted in FIG. **2**, container assembly **16** comprises a container **18** having a side **20** that extends from an upper end **22** to an opposing lower end **24**. Container **18** also has an interior surface **26** that bounds a compartment **28**. Compartment **28** is configured to hold a fluid. In the embodiment depicted, container **18** comprises a flexible bag that is comprised of a flexible, water impermeable material such as a low-density polyethylene or other polymeric sheets having a thickness in a range between about 0.1 mm to about 5 mm with about 0.2 mm to about 2 mm being more common. Other thicknesses can also be used. The material can be comprised of a single ply material or can comprise two or more layers which are either sealed together or separated to form a double wall container. Where the layers are sealed together, the material can comprise a laminated or extruded material. The laminated material comprises two or more separately formed layers that are subsequently secured together by an adhesive.

The extruded material comprises a single integral sheet that comprises two or more layers of different materials that can be separated by a contact layer. All of the layers are simultaneously co-extruded. One example of an extruded material that can be used in the present invention is the HyQ CX3-9 film available from HyClone Laboratories, Inc. out of Logan, Utah. The HyQ CX3-9 film is a three-layer, 9 mil cast film produced in a cGMP facility. The outer layer is a polyester elastomer coextruded with an ultra-low density polyethylene product contact layer. Another example of an extruded material that can be used in the present invention is the HyQ CX5-14 cast film also available from HyClone Laboratories, Inc. The HyQ CX5-14 cast film comprises a polyester elastomer outer layer, an ultra-low density polyethylene contact layer, and an EVOH barrier layer disposed therebetween. In still another example, a multi-web film produced from three independent webs of blown film can be used. The two inner webs are each a 4 mil monolayer polyethylene film (which is referred to by HyClone as the HyQ BM1 film) while the outer barrier web is a 5.5 mil thick 6-layer coextrusion film (which is referred to by HyClone as the HyQ BX6 film).

The material is approved for direct contact with living cells and is capable of maintaining a solution sterile. In such an embodiment, the material can also be sterilizable such as by ionizing radiation. Examples of materials that can be used in different situations are disclosed in U.S. Pat. No. 6,083,587 which issued on Jul. 4, 2000 and U.S. Patent Publication No. US 2003-0077466 A1, published Apr. 24, 2003 which are hereby incorporated by specific reference.

In one embodiment, container **18** comprise a two-dimensional pillow style bag wherein two sheets of material are placed in overlapping relation and the two sheets are bonded together at their peripheries to form the internal compartment. Alternatively, a single sheet of material can be folded over and seamed around the periphery to form the internal compartment. In another embodiment, the containers can be formed from a continuous tubular extrusion of polymeric material that is cut to length and is seamed closed at the ends.

In still other embodiments, container **18** can comprise a three-dimensional bag that not only has an annular side wall but also a two dimensional top end wall and a two dimensional bottom end wall. Three dimensional containers comprise a plurality of discrete panels, typically three or more, and more commonly four or six. Each panel is substantially identical and comprises a portion of the side wall, top end wall, and bottom end wall of the container. Corresponding perimeter edges of each panel are seamed. The seams are typically formed using methods known in the art such as heat energies, RF energies, sonics, or other sealing energies.

In alternative embodiments, the panels can be formed in a variety of different patterns. Further disclosure with regard to one method of manufacturing three-dimensional bags is disclosed in United States Patent Publication No. U.S. 2002-0131654 A1 that was published Sep. 19, 2002 of which the drawings and Detailed Description are hereby incorporated by reference.

It is appreciated that container **18** can be manufactured to have virtually any desired size, shape, and configuration. For example, container **18** can be formed having a compartment sized to 10 liters, 30 liters, 100 liters, 250 liters, 500 liters, 750 liters, 1,000 liters, 1,500 liters, 3,000 liters, 5,000 liters, 10,000 liters or other desired volumes. Although container **18** can be any shape, in one embodiment container **18** is specifically configured to be complementary or substantially complementary to the chamber on container station **14** in which container **18** is received, as will be discussed below.

In any embodiment, however, it is desirable that when container **18** is received within the chamber on container station **14**, container **18** is at least generally uniformly supported by container station **14**. Having at least general uniform support of container **18** by container station **14** helps to preclude failure of container **18** by hydraulic forces applied to container **18** when filled with fluid.

Although in the above discussed embodiment container **18** has a flexible, bag-like configuration, in alternative embodiments it is appreciated that container **18** can comprise any form of collapsible container or semi-rigid container. Container **18** can also be transparent or opaque and can have ultraviolet light inhibitors incorporated therein.

Continuing with FIG. **2**, formed on container **18** are a plurality of ports **30** at upper end **22** and a plurality of ports **31** and **32** on opposing sides of side **20** at lower end **24**. Each of ports **30-32** communicate with compartment **28**. Although only a few ports **30-32** are shown, it is appreciated that container **18** can be formed with any desired number of ports **30-32** and that ports **30-32** can be formed at any desired

location on container **18**. Ports **30-32** can be the same configuration or different configurations and can be used for a variety of different purposes. For example, ports **30** can be coupled with fluid lines for delivering media, cell cultures, and/or other components into container **18** and withdrawing gas from container **18**. Ports **31** and/or **32** can be useful in withdrawing fluid from container **18** or can have other purposes.

Ports **30-32** can also be used for coupling probes to container **18**. For example, when container **18** is used as a bioreactor for growing cells or microorganisms, ports **30-32** can be used for coupling probes such as temperatures probes, pH probes, dissolved oxygen probes, and the like. Examples of ports **30-32** and how various probes and lines can be coupled thereto is disclosed in U.S. Patent Publication No. 2006-0270036, published Nov. 30, 2006 and U.S. Patent Publication No. 2006-0240546, published Oct. 26, 2006, which are incorporated herein by specific reference. Ports **30-32** can also be used for coupling container **18** to secondary containers, to condenser systems, and to other desired fittings.

As also shown in FIG. **2**, container assembly **16** can comprise a plurality of radially spaced apart alignment tabs **38** projecting from lower end **24** of container **18**. In the embodiment depicted, each alignment tab **38** comprises a single tab welded to container **18** and having a opening **39** extending therethrough. In alternative embodiments, alignment tabs **38** can comprise a loop of material that bound an opening passing therethrough or can have other configurations that permit the tab to attach to a structure. As discussed below in greater detail, alignment tabs **38** can be used for proper positing of container assembly **16** within container station **14**.

In one embodiment of the present invention, container assembly **16** includes means for delivering a gas into the lower end of container **18**. By way of example and not by limitation, container assembly **16** can comprise a sparger **34** positioned either on or mounted to lower end **24** of container **18** for delivering a gas to the fluid within container **18**. As is understood by those skilled in the art, various gases are typically required in the growth of cells or microorganisms within container **18**. The gas typically comprises air that is selectively combined with oxygen, carbon dioxide and/or nitrogen. However, other gases can also be used. The addition of these gases can be used to regulate the dissolved oxygen content and pH of a culture. A gas line **36** is coupled with sparger **34** for delivering the desired gas to sparger **34**. Gas line **36** need not pass through lower end **24** of container **18** but can extend down from upper end **22** or from other locations.

Sparger **34** can have a variety of different configurations. For example, sparger **34** can comprise a permeable membrane or a fritted structure comprised of metal, plastic or other materials that dispense the gas in small bubbles into container **18**. Smaller bubbles can permit better absorption of the gas into the fluid. In other embodiments, sparger **34** can simply comprise a tube, port, or other type opening formed on or coupled with container **18** through which gas is passed into container **18**. In contrast to being disposed on container **18**, the sparger can also be formed on or coupled with impeller **64** which is discussed below. Examples of spargers and how they can be used in the present invention are disclosed in U.S. Patent Publication Nos. 2006-0270036 and 2006-0240546 which were previously incorporated by reference. Other conventional spargers can also be used.

Container assembly **16** further comprises an impeller assembly **40**. As depicted in FIG. **3**, impeller assembly **40** comprises an elongated tubular connector **44** having a rotational assembly **48** mounted at one end and an impeller **64** mounted on the opposing end. More specifically, tubular connector **44** has a first end **46** and an opposing second end **48** with a passage **50** that extends therebetween. In one embodiment, tubular connector **44** comprises a flexible tube such as a polymeric tube. In other embodiments, tubular connector **44** can comprise a rigid tube or other tubular structure.

Rotational assembly **48** is mounted to first end **46** of tubular connector **44**. Rotational assembly **48** comprises an outer casing **50** having an outwardly projecting flange **52** and a tubular hub **54** rotatably disposed within outer casing **50**. A bearing assembly can be disposed between outer casing **50** and tubular hub **54** to permit free and easy rotation of hub **54** relative to casing **50**. Likewise, one or more seals can be formed between outer casing **50** and tubular hub **54** so that during use an aseptic seal can be maintained between outer casing **50** and tubular hub **54** as tubular hub **54** rotates relative to outer casing **50**.

Hub **54** has an interior surface **56** that bounds an opening **58** extending therethrough. As will be discussed below in greater detail, an engaging portion of interior surface **56** has a polygonal or other non-circular transverse cross section so that a driver portion of drive shaft **362** passing through opening **58** can engage the engaging portion and facilitate rotation of hub **54** by rotation of drive shaft **362**. Hub **54** can also comprise a tubular stem **60** projecting away from outer casing **50**. Hub **54** can couple with first end **44** of tubular connector **42** by stem **60** being received within first end **44**. A pull tie, clamp, crimp or other fastener can then be used to further secure stem **60** to tubular connect **42** so that a liquid tight seal is formed therebetween. Other conventional connecting techniques can also be used.

Impeller **64** comprises a central hub **66** having a plurality of fins **68** radially outwardly projecting therefrom. It is appreciated that a variety of different numbers and configurations of fins **68** can be mounted on hub **66**. Hub **66** has a first end **70** with a blind socket **72** formed thereat. Socket **72** typically has a noncircular transverse cross section, such as polygonal, so that it can engage a driver portion of drive shaft **362**. Accordingly, as will be discussed below in greater detail, when a driver portion is received within socket **72**, the driver portion engages with impeller **64** such that rotation of drive shaft **362** facilities rotation of impeller **64**.

In one embodiment, hub **66** and fins **68** of impeller **64** are molded from a polymeric material. In alternative embodiments, hub and fins **68** can be made of metal, composite, or a variety of other materials. If desired, an annular insert can be positioned within socket **72** to help reinforce hub **66**. For example, the insert can be comprised of metal or other material having a strength property greater than the material from which hub **66** is comprised.

Impeller **64** can be attached to connector **42** by inserting first end **70** of hub **66** within connector **42** at second end **46**. A pull tie, clamp, crimp, or other type of fastener can then be cinched around second end **46** of connector **42** so as to form a liquid tight sealed engagement between impeller **64** and connector **42**.

Returning to FIG. **2**, rotational assembly **48** is secured to container **18** so that tubular connector **42** and impeller **64** extend into or are disposed within compartment **28** of container **18**. Specifically, in the depicted embodiment container **18** has an opening **74** at upper end **22**. Flange **52** of outer casing **50** is sealed around the perimeter edge bounding opening **74** so that hub **54** is aligned with opening **74**. Tubular connector **42** having impeller **64** mounted on the end thereof projects from hub **54** into compartment **28** of container **18**. In this configuration, outer casing **50** is fixed to container **18** but hub **54**, and thus also tubular connector **42** and impeller **64**, can freely rotate relative to outer casing **50** and container **18**.

As a result of rotational assembly **48** sealing opening **74**, compartment **28** is sealed closed so that it can be used in processing sterile fluids.

As depicted in FIG. **3**, impeller assembly **40** is used in conjunction with drive shaft **362**. In general drive shaft **362** comprises a head section **364** and a shaft section **366** that can be coupled together by threaded connection or other techniques. Alternatively, draft shaft **362** can be formed as a single piece member or from a plurality of attachable sections. Drive shaft **362** has a first end **368** and an opposing second end **370**. Formed at first end **368** is a frustoconical engaging portion **372** that terminates at a circular plate **374**. Notches **376** are formed on the perimeter edge of circular plate **374** and are used for engaging drive shaft **362** with a drive motor assembly as will be discussed below.

Formed at second end **370** of drive shaft **362** is a driver portion **378**. Driver portion **378** has a non-circular transverse cross section so that it can facilitate locking engagement within hub **66** of impeller **64**. In the embodiment depicted, driver portion **378** has a polygonal transverse cross section. However, other non-circular shapes can also be used. A driver portion **380** is also formed along drive shaft **362** toward first end **368**. Driver portion **380** also has a non-circular transverse cross section and is positioned so that it can facilitate locking engagement within the interior surface of hub **54** of rotational assembly **48**.

During use, as will be discussed below in further detail, drive shaft **362** is advanced down through hub **54** of rotational assembly **48**, through tubular connecter **42** and into hub **66** of impeller **64**. As a result of the interlocking engagement of driver portions **378** and **380** with hubs **66** and **54**, respectively, rotation of drive shaft **362** by a drive motor assembly facilitates rotation of hub **54**, tubular connecter **42** and impeller **64** relative to outer casing **50** of rotational assembly **48**. As a result of the rotation of impeller **64**, fluid within container **18** is mixed.

It is appreciated that impeller assembly **40**, drive shaft **362** and the discrete components thereof can have a variety of different configuration and can be made of a variety of different materials. Alternative embodiments of and further disclosure with respect to impeller assembly **40**, drive shaft **362**, and the components thereof are disclosed in U.S. patent application Ser. No. 12/697,771 filed Feb. 1, 2010 which is incorporated herein in its entirety by specific reference.

Returning to FIG. **1**, container station **14** comprises a support housing **78** supported on a cart **80**. Support housing **78** has a substantially cylindrical sidewall **82** that extends between an upper end **84** and an opposing lower end **86**. Lower end **86** has a floor **88** (FIG. **6**) mounted thereto. As a result, support housing **14** has an interior surface **90** that bounds a chamber **92**. An annular lip **94** is formed at upper end **84** and bounds an opening **96** to chamber **92**. As discussed above, chamber **92** is configured to receive container assembly **16** so that container **18** is supported therein.

Although support housing **78** is shown as having a substantially cylindrical configuration, in alternative embodiments support housing **78** can have any desired shape capable of at least partially bounding a compartment. For example, sidewall **82** need not be cylindrical but can have a variety of other transverse, cross sectional configurations such as polygonal, elliptical, or irregular. Furthermore, it is appreciated that support housing **78** can be scaled to any desired size. For example, it is envisioned that support housing **78** can be sized so that chamber **92** can hold a volume of less than 50 liters, more than 1,000 liters or any of the other volumes as discussed above with regard to container **18**. Support housing **78** is typically made of metal, such as stainless steel, but can also be made of other materials capable of withstanding the applied loads of the present invention.

With continued reference to FIG. **1**, sidewall **82** of support housing **78** has a first side face **100** and an opposing second side face **102**. An enlarged access **104** is formed on second side face **102** at lower end **86** so as to extend through sidewall **82**. A door **106** is hingedly mounted to sidewall **82** and can selectively pivot to open and close access **104**. A latch assembly **108** is used to lock door **106** in the closed position. An opening **110**, which is depicted in the form of an elongated slot, extends through door **106**. Opening **110** is configured to align with ports **32** (FIG. **2**) of container assembly **16** when container station **14** is received within chamber **92** so that ports **32** project into or can otherwise be accessed through opening **110**. In some embodiments, a line for carrying fluid or gas will be couple with port **32** and can extend out of chamber **29** through opening **110**. As previously mentioned, any number of ports **32** can be formed on container **18** and thus a number of separated lines may pass out through opening **110**. Alternatively, different types of probes, inserts, connectors or the like may be coupled with ports **32** which can be accessed through opening **110**.

Turning to FIG. **4**, similar to second side face **102**, an enlarged access **114** is formed on first side face **100** at lower end **86** so as to extend through sidewall **82**. A door **116** is hingedly mounted to sidewall **82** and can selectively pivot to open and close access **114**. A latch assembly **118** is used to lock door **116** in the closed position. An opening **120**, which is depicted in the form of an elongated slot, extends through door **116**. Opening **120** is configured to align with ports **32** (FIG. **2**) of container assembly **16** when container assembly **16** is received within chamber **92** and serves the same corresponding function as discussed above with regard to opening **110**.

As shown in FIG. **1**, door **106** has an exterior surface **107** that is substantially flush with the exterior surface of side wall **82** when door **106** is in the closed position. In contrast, as shown in FIG. **5**, door **116** has a perimeter frame **128** that includes a first side rail **129**, a spaced part second side rail **130**, an upper rail **131** that extends between the upper ends of rails **129** and **130**, and a lower rail **132** that extends between the lower ends of rails **129** and **130**. Each of rails **129-132** has an inside face **134** that extends between an interior surface **136** and an exterior surface **138**. Door **116** further includes a panel **140** having a front face **142** and an opposing back face **144**. Panel **140** is mounted on or adjacent to inside face **134** of rails **129-132** so that back face **144** of panel **140** is disposed substantially flush with interior surface **80** of support housing **78** when door **116** is in the closed position. Panel **140** has opening **120** extending therethrough. As a result of the position of panel **140**, a recess **146** is formed on door **116** that is bounded in part by front face **142** of panel **140** and inside face **134** of rails **129-132**.

An elongated rack **148** is connected to and extends between inside faces **134** of side rails **129** and **130** so that rack **148** is retained within recess **146**. In the depicted embodiment rack **148** comprises a flat bar that is curved along the length thereof. Alternatively, other support structures can also be used. Rack **148** is positioned so as to be slightly above or aligned with opening **120**. Rack **148** is disposed within recess **148** to help protect it from damage during movement, shipping or use of container station **14**. In alternative embodiments, rack **148** can project outside of recess **146**, can be mounted on exterior faces of rails **129** and **130** or can be formed in a generally elongated U-shaped configuration and mounted on the exterior surface of door **116**.

Rack **148** is used to support one or more removable hose supports **150**. As shown in FIG. **5**, each hose support **150** comprises an elongated shaft **152** having a first end **154** and an opposing second end **156**. Mounted at first end **154** is a conventional hose clamp **158**. Hose clamp **158** comprises a pair of resiliently flexible arms that can be manually pried apart. Once the hose is positioned between the arms, the arms resiliently press back toward each other so as to secure the hose therebetween. Other hose clamps or other structures capable of holding or securing a hose can also be used. Downwardly projecting from second end **156** of shaft **152** is a pair of spaced apart rigid arms **160** and **161** that bound a slot **162** therebetween. Hose support **150** is attached to rack **148** by sliding rack **148** into slot **162**. A set screw **164** can then be threaded through arm **160** to bias against rack **148** so as to secure hose clamp **150** to rack **148**. Other conventional mounting structures can also be used for removably securing hose support **150** to rack **148**.

Hose clamps **150** are used for supporting hoses that extend out of opening **120** and are coupled with corresponding ports **31** (FIG. **2**). Hose clamps **150** help keep the hoses organized and prevent unwanted kinking. It is appreciated that any number of hose clamps **150** can be attached to rack **148**. During shipping or movement of container station **14**, hose clamps **150** can be removed so that they are not damaged and do not form an obstruction.

Accesses **104** and **114** (FIGS. **1** and **4**) are in part provided so that when container assembly **16** is being inserted within chamber **92**, an operator can reach into chamber **92** through access **104** and/or **114** to help orientate and secure container assembly **16** within chamber **92** and to help align and/or feed various ports and tubes extends from container assembly **16** with or through corresponding openings **110**, **120**, and the like on support housing **78**. In alternative embodiments, it is appreciated that door **106** can be used on both accesses **104** and **114** or that door **116** can be used on both access **104** and **114**. In other embodiments, support housing **78** can be formed with only one of access **104** or **114** or that both access **104** and **114** can be eliminated and opening **110** and/or **120** can be formed directly on sidewall **82**.

Returning to FIG. **4**, a plurality of radially spaced apart alignment openings **168** extend through sidewall **82** of support housing **78** at lower end **86**. A catch **170** laterally projects from an exterior surface of sidewall **82** into alignment with each alignment opening **168**. As container assembly **16** is being inserted into chamber **92** of support housing **78**, before it is filled with fluid, container **18** is spread apart and alignment tabs **38** (FIG. **2**) of container assembly **16** are advanced through corresponding alignment openings **168** and secured to a corresponding catch **170**. This positioning helps ensure that container assembly **16** is properly positioned and spread apart so that container **18** fully and properly expands during filling with fluid as opposed to parts of container **18** being kinked or remaining folded during filling. It is appreciated that catches **170** can have a variety of different configuration and can also be in the form of straps, elastic cords or the like that can engage and secure tabs **38** to container station **14**.

As shown in FIG. **1**, support housing **78** can also comprise a handle **174** attached to an outwardly extending sidewall **82**. Handle **174** is shown having an elongated U-shaped configuration but can also have other designs. A plurality of vertically aligned observation slot **176** extend along the height of sidewall **82** and extend through sidewall **82** so as to communicate with chamber **92**. Observation slots **176** permit and easy verification of the level of fluid within container **18**.

Turning to FIG. **6**, floor **88** of support housing **78** has an enlarged central opening **176** into which a plate **178** is removably positioned. Plate **178** has a slot **180** that extends from a perimeter edge of plate **178** toward a center of plate **178**. As such, plate **178** has a generally C-shaped configuration. Plate **178** typically freely sits on floor **88** and can be removed by being pushed up into chamber **92**. During use, as container assembly **16** is lowered into chamber **92**, a user can push plate **178** out of opening **176** and reach up through opening **176** to grasp gas line **36**. Gas line **36** is then pulled down through opening **176** and sparger **34** (FIG. **2**) is directed towards opening **176**. Finally, gas line **36** passes into slot **180** and plate **178** is fitted within opening **176** so that sparger **34** rests on or is disposed adjacent to plate **178**.

In one embodiment of the present invention means are provided for regulating the temperature of the fluid that is contained within container **18** when container **18** is disposed within support housing **78**. By way of example and not by limitation, sidewall **82** can be jacketed so as to bound one or more fluid channels that encircle sidewall **82** and that communicate with an inlet port **184** and an outlet port **186**. A fluid, such as water or propylene glycol, can be pumped into the fluid channel through inlet port **184**. The fluid then flows in pattern around sidewall **82** and then exits out through outlet port **184**.

By heating or otherwise controlling the temperature of the fluid that is passed into the fluid channel, the temperature of support housing **78** can be regulated which in turn regulates the temperature of the fluid within container **18** when container **18** is disposed within support housing **78**. In an alternative embodiment, electrical heating elements can be mounted on or within support housing **78**. The heat from the heating elements is transferred either directly or indirectly to container **18**. Alternatively, other conventional means can also be used such as by applying gas burners to support housing **78** or pumping the fluid out of container **18**, heating the fluid and then pumping the fluid back into container **18**. When using container **18** as part of a bioreactor or fermenter, the means for heating can be used to heat the culture within container **18** to a temperature in a range between about 30° C. to about 40° C. Other temperatures can also be used.

Returning to FIG. **4**, cart **80** comprises a platform **190** having a top surface **192** and an opposing bottom surface **194**. In the depicted embodiment, platform **190** has a substantially triangular configuration. In alternative embodiments, however, platform **190** can be square, rectangular, circular, or of other polygonal or irregular configurations. Downwardly projecting from bottom surface **194** are a plurality of spaced apart wheels **196**. A plurality of spaced apart legs **198** extend between floor **88** of support housing **78** and top surface **192** of platform **190**. Legs **198** provide an open gap between support housing **78** and platform **190** so as to enable access to plate **178** (FIG. **6**) as previously discussed.

Attached to and downwardly projecting from platform **190** is a locking catch **200**. As perhaps better depicted in FIG. **6**, locking catch **200** comprises a vertically extending face plate **202** and a pair of arms **204**A and **204**B project back from opposing sides of face plate **202** in complementary diverging angles so as to extend in a generally V-shaped orientation. Arm **204**A has a first flange **206**A and an second flange **208**A orthogonally projecting from opposing upper and lower ends of arms **204**A so as to be disposed in substantially parallel planes. An engagement rod **210**A is secured to and extends between flanges **206**A and **206**B at a spaced apart location from arm **204**A. Similarly, flanges **206**B and **208**B extend from opposing upper and lower ends of arm **204**B and have an engagement rod **21** OB extending therebetween. The operation and function of locking catch **200** will be discussed below in greater detail with regard to docking station **12**.

As depicted in FIG. **7**, docking station **12** comprises stand **218** which includes a base **220** having a frame assembly **222** upstanding therefrom and a plurality of wheels **224** downwardly projecting therefrom. More specifically, base **220** comprises a pair of spaced apart runners **266**A and **226**B extending in parallel alignment. A first cross member **228** extends between runners **266**A and **266**B at a rearward end thereof while a second cross member **230** extends between runners **266**A and **266**B at a forward end thereof. A wheel **224** downwardly projects from each opposing end of each runner **266**A and **266**B. Frame assembly **222** comprises a plurality of spaced apart vertical risers **232** having a plurality of lateral supports **234** extending therebetween. A horizontal platform **236** is mounted on frame assembly **222** forward of and at an elevation above first cross member **228**. A pair of spaced apart hand rails **238**A and **238**B extend from corresponding runner **226**A and **226**B and connect with frame assembly **222**.

Mounted on second cross member **230** of base **220** is a locking assembly **244**. Locking assembly **244** comprises a housing **246** having a front face **248**. As depicted in FIG. **8**, front face **248** comprises an outwardly flaring, substantially U-shaped receiver **250** having end faces **252**A and **252**B extending from the opposing ends thereof. Access slots **254**A and **254**B are formed on end faces **252**A and **252**B, respectively. Receiver **250** bounds a recess **256** of complimentary shape that is configured to receive face plate **202**. Locking assembly **244** further comprises a pair of engaging arms **258**A and **258**B. Each arm **258**A and **258**B has a first end **260** disposed within housing **246** and an opposing second end **262** that projects out through a corresponding access slot **254**. Engaging arms **258**A and **258**B have a notch **264**A and **264**B, respectively, that are opposingly facing.

Engaging arms **258**A and **258**B can be movably positioned between a locking position as shown in FIG. **8** wherein second end **262** of arms **258** pivot towards each other and a release position wherein second end **262** of engaging arms **258** are pivoted away from each other. A mechanical assembly is used for moving engaging arms **258** between the two positions. The mechanical assembly includes an axel **266**A secured to housing **246** and extending through first end **260** of engaging arm **258**A so that engaging arm **258**A can pivot about axel **266**A. A pivot plate **268**A is secured to first end **260** of engaging arm **258**A so as to also pivot about axel **266**A. A linkage **270**A has a first end **272**A pivotally mounted to pivot plate **268**A and an opposing second end **274**A mounted to a guide pin **276**. Guide pin **276** can pivot within and slide along a guide slot **278** that is formed on a bracket **280**. Bracket **280** is secured to housing **246**. A corresponding axel **266**B, pivot plate **268**B, and linkage **270**B are similarly coupled with engaging arm **258**B. A lever **282** is pivotally mounted to housing **246** or base **220** and includes a first end **284** coupled with guide pin **276** and an opposing second end **286** (FIG. **7**). As a result of the mechanical linkage, manual manipulation of second end **286** of lever **282** pivots engaging arms **258**A and **258**B between the locking and release positions. Finally, locking assembly **244** also includes a spring **288** resiliently extending between pivot plates **268**A and **268**B a location forward of axels **266**A and **266**B. As a result of this configuration, spring **288** functions to resiliently pivot second end **262** of engaging arms **258**A and **258**B towards each other.

During use, it is desirable to engage locking assembly **244** with locking catch **200** so that container station **14** is rigidly locked with docking station **12**. This is accomplished by advancing locking catch **200** into recess **256** of locking assembly **244**. Locking catch **200** has a configuration complimentary to and is configured to nest within recess **256** so that the structures are self aligning as they couple together. As locking catch **200** advances into recess **256**, engagement rods **210** strike against the inside face of engagement arms **258**A and **258**B, respectively. Because of the inward sloping of the faces, engagement arms **258**A and **258**B resiliently flex outward against the resistant spring **288** as engagement rods **210** are advanced forward.

Finally, once engagement rods **210** are advanced to notches **264**A and **264**B, engagement arms **258** resiliently pivot inward thereby retaining engagements rods **210**A and **210**B within notches **252**A and **252**B. In this position, container station **14** is rigidly secured to docking station **12**. As discussed below in greater detail, in this position, docking station **12** can be used to facilitate mixing and other processing of fluid within container assembly **16**. When it is desired to separate container station **14** from docking station **12**, lever **282** is moved so that engagement arms **258** are spread apart into the release position thereby releasing engagement with locking catch **200**. It is appreciated that there are a variety of different types of locking systems that can be used for removably securing container station **14** to docking station **12**.

Returning to FIG. **7**, docking station **12** further comprises a drive motor assembly **300** coupled with stand **218** by an adjustable arm assembly **302**. Drive motor assembly **300** is used in conjunction with drive shaft **362** (FIG. **3**) and can be used for mixing and/or suspending a culture or other solution within container **18** (FIG. **2**). Turning to FIG. **9**, drive motor assembly **18** comprises a housing **304** having a top surface **306** and an opposing bottom surface **308**. An opening **310** extends through housing **304** from top surface **306** to bottom surface **308**. A tubular motor mount **312** is rotatably secured within opening **310** of housing **304**. Upstanding from motor mount **312** is a locking pin **316**. A drive motor **314** is mounted to housing **304** and engages with motor mount **312** so as to facilitate select rotation of motor mount **312** relative to housing **304**. Drive shaft **362** is configured to pass through motor mount **312** so that engaging portion **372** of drive shaft **362** is retained within motor mount **312** and locking pin **316** of motor mount **312** is received within notch **376** of drive shaft **362**. As a result, rotation of motor mount **312** by drive motor **314** facilitates rotation of drive shaft **362**. Further discussion of drive motor assembly **300** and how it engages with drive shaft **362** and alternative designs of drive motor assembly **300** are discussed in U.S. patent application Ser. No. 12/697,771 which was previously incorporated herein by specific reference.

Arm assembly **302** is used to adjust the position of drive motor assembly **300** and thereby also adjust the position of drive shaft **362**. As depicted in FIG. **10**, arm assembly **302** comprises a first housing **318** that is rigidly secured to stand **218**. Slidably disposed within first housing **318** is an elongated first support **320**. First housing **318** and first support **320** are orientated such that first support **320** can slide vertically up and down along a first axis **322** (FIG. **11**). In one embodiment, axis **322** can extend orthogonally to a horizontal surface on which docking station **12** is disposed. In alternative embodiments, first housing **318** and first support **320** can be disposed so that axis **322** is disposed at an angle in a range between 0° to about 30° relative to a horizontal surface. Other angles can also be used.

In one embodiment of the present invention, means are provided for selectively locking first support **320** to first housing **318** at different locations along axis **322**. In one embodiment of the present invention, such means comprises holes **324** formed at spaced apart locations along first support **320** and a spring activated pin **326** mounted to first housing **318**. By pulling **326** out pin **326**, first support **320** is free to slide vertically up and down along axis **322**. By pushing the pin **326**

in, pin **326** is received within a corresponding hole **324** so as to lock first support **320** in place. It is appreciated that any number of conventional clamps, pins, screws, latches, fasteners, or the like can be used for securing first support **320** to first housing **318**. Indicia or markings **328** can be formed along the surface of first support **320** to indicate the relative position of first support **320**.

First support **320** terminates at an upper end **330**. Mounted on upper end **330** is a second housing **332**. A second support **334** has a fist end **352** and an opposing second end **354**. First end **352** is slidably mounted on second housing **332** so that second support **334** can be positioned at various locations along a second axis **335**. Second support **334** and second housing **332** are typically disposed so that second axis **335** is horizontally disposed and is orthogonal to first axis **322**. In alternative embodiments, however, second axis **335** can be disposed at an angle in a range between 0° to about 30° relative to first axis **322**. Other angles can also be used.

Rails are typically disposed within second housing **332** on which second support **334** slides. In alternative embodiments, a variety of alternative mechanism can be used to permit second support **334** to slide relative to second housing **332**. In one embodiment of the present invention, means are provided for selectively locking second support **334** at different locations along second housing **332**. By way of example and not by limitation, second housing **332** is shown having a top surface **336** having an elongated slot **338** formed along the length thereof. A spring actuated pin is disposed within slot **338** and extends through second support **334**. A plurality of spaced apart holes are formed on the bottom surface of second housing **332** or along the rails or other structures disposed within second house **332**. During use, when pin **340** is elevated, second support **334** is free to slide back and forth along second housing **332** along second axis **335**. When pin **340** is pressed down, pin **340** is received within a hole to thereby lock pin **340** and second support **334** in place. Indicia **342** can be disposed on top surface **336** to identify predefined locations for second support **344**.

A third support **346** is rotatably mounted to second end **354** of second support **334**. Third support **346** is mounted so that it rotates about a third axis **348**. Third axis **348** can be disposed in a horizontal plane and or in the same plane as second axis **335**. Third axis can also be disposed at an angle in a range between about 0° to about 30° relative to second axis **335**. Drive motor assembly **300** is secured to third support **346** such that rotation of third support **346** facilitates concurrent rotation of drive motor assembly **300**.

One embodiment of the present invention also includes means for locking third support **346** at different angles about third axis **348**. By way of example and not by limitation, a spring activated pin **350** is mounted on third support **346**. When pin **350** is retracted, third support **346** is free to rotate about third axis **348**. As pin **350** is advanced inward, it is received within one of a plurality of holes formed on second end **354** of second support **334**. As a result, third support **346** is thereby precluded from further rotation. Other conventional fastening techniques can also be used.

In view of the foregoing, first support **320** can facilitate vertical movement of drive motor assembly **300**, second support **334** can facilitate horizontal movement of drive motor assembly **300** and third support **346** can facilitate rotational movement of drive motor assembly **300**. As a result, arm assembly **302** can be used to position drive motor assembly **300** and drive shaft **362** which extends there through in a variety of different locations and orientations. As a result, arm assembly **302** enables docking system station **12** to be used with a variety of different sized and shaped container stations **14**.

During use, container station **14** is wheeled to docking station **12** and/or docking station **12** is wheeled to container station **14** and the two are securely coupled together, as shown in FIG. **1**, by engaging locking assembly **244** (FIG. **7**) with catch **200** (FIG. **4**). In this secure position, arm assembly **302** is used to properly position drive motor assembly **300** so that rotational assembly **48** (FIG. **2**) can be coupled with drive motor assembly **300**. Specifically, as depicted in FIG. **12**, housing **304** of drive motor assembly **300** has an open access **384** that is recessed on a front face **386** so as to communicate with opening **310** extending through housing **304**. Access **384** is in part bounded by a substantially C-shaped first side wall **388** that extends up from bottom surface **308**, a concentrically disposed substantially C-shaped second side wall **390** disposed above first side wall **388** and having a diameter larger than first side wall **388**, and a substantially C-shaped shoulder **392** extending between side walls **388** and **390**. As shown in FIG. **2**, a door **394** is hingedly mounted to housing **304** and selectively closes the opening to access **384** from front face **386**. Returning to FIG. **12**, door **394** is secured in a closed position by a latch **396**. Positioned on first side wall **388** is a section **398** of a resilient and/or elastomeric material such as silicone. Other sections **398** of similar materials can also be positioned on first side wall **388** or the interior surface of door **394**.

As depicted in FIG. **13**, to facilitate attachment of rotational assembly **48** to housing **304**, with door **394** rotated to an open position, rotational assembly **48** is horizontally slid into access **384** from front face **386** of housing **304** so that a support flange **400** radially outwardly extending from an upper end of rotational assembly **48** rests on shoulder **392** of access **384**. Rotational assembly **48** is advanced into access **384** so that the passage extending through hub **54** of rotational assembly **48** aligns with the passage extending through motor mount **312** (FIG. **9**). In this position, door **394** is moved to the closed position and secured in the closed position by latch **396**. As door **394** is closed, casing **50** of rotational assembly **48** is biased against the one or more sections **398** (FIG. **12**) of resilient material so as to clamp rotational assembly **48** within access **384** and thereby prevent unwanted rotational movement of casing **50** relative to housing **304** of drive motor assembly **300**.

Once rotational assembly **48** is secured to drive motor assembly **300**, drive shaft **362** can be advanced down through drive motor assembly **300** and into impeller assembly **40** so as to engage impeller **64**. Once drive shaft **362** is properly positioned, drive motor assembly **300** is activated causing drive shaft **362** to rotate impeller **64** and thereby mix or suspend the fluid within container **18**. When the processing is complete, drive shaft **362** is removed and rotational assembly **48** is separated from drive motor assembly **300**. Container station **14** can then be separated from docking station **12** by releasing catch **200** from locking assembly **244**. A second container station **14** can then be couple with docking station **12** in the same manner as discussed above. Where the second container station **14** is a different size or configuration or where the container assembly **16** coupled thereto is a different size or configuration, arm assembly **302** can be used to properly position drive motor assembly **300** at a potentially different location so that the new rotational assembly **48** can be coupled with drive motor assembly **300**. Drive shaft **362** can then again be advanced down through drive motor assembly **300** and into impeller assembly **40** of the new container assembly **16**.

In view of the foregoing, it is appreciated that a single docking station **14** can be used with a variety of different container stations **14** and/or container assemblies **16** wherein the different container stations **14** and/or container assemblies **16** can be of different size and/or shape.

Depicted in FIG. **14** is an alternative embodiment of the present invention. In this embodiment drive motor assembly **300** operates with a container **404** that is an open top liner. Container **404** is positioned within chamber **92** of support housing **78** so that is drapes over annular lip **94** (FIG. **1**). This configuration can be used as a lower cost alternative for mixing non-sterile fluids. In this embodiment, rotational assembly **48** merely functions to secure impeller assembly **40** to drive motor assembly **300** so that it does not unintentionally slide off of drive shaft **362**. In alternative embodiments, because rotational assembly **48** is no longer forming a sealed fluid connection with the container, rotational assembly **48** can be substantially simplified. For example, as shown in FIG. **15**, rotational assembly **48** can be replaced by a clamp **406** that secures tubular connector **42** to drive shaft **362**. Further alternative embodiments with regard to impeller assembly **40** and how they can be attached to drive motor assembly **300** or drive shaft **362** are discussed in U.S. patent application Ser. No. 12/697,771 which was previously incorporated herein by specific reference.

Depicted in FIG. **16** is an alternative embodiment of an inventive mixing system **10**A incorporating features of the present invention. Like elements between systems **10** and **10**A are identified by like reference characters. In general, mixing system **10**A comprises docking station **12**, a container station **14**A that removeably docks with docking station **12**, a container assembly **16**A that is supported within container station **14**A, and drive shaft **362** (FIG. **3**) that extends between docking station **12** and container assembly **16**A.

As depicted in FIG. **17**, container assembly **16**A comprises container **18** having impeller assembly **40** attached thereto the same as in container assembly **16**. However, in contrast to container assembly **16** which was designed to function as part of a fermentor or bioreactor, container assembly **16**A is primarily designed for mixing and transporting fluids. As such, sparger **34** of container assembly **16** has been removed and replaced with a port **410** centrally secured on a floor **411** of container **18**. A drain line **412**, which is typically in the form of a flexible tube, is coupled to and extends from port **410**. A hose clamp **413**, as is known in the art, can be attached to drain line **412** for controlling the flow of fluid therethrough.

Container assembly **16**A also comprises a plurality of radially spaced apart alignment tabs **414** projecting from upper end **22** of container **18**. In the embodiment depicted, each alignment tab **414** comprises a single tab welded to container **18** and having a opening **415** extending therethrough. In alternative embodiments, alignment tabs **414** can comprise a loop of material that bound an opening passing therethrough or can have other configurations that permit the tab to attach to a structure. As will be discussed below in greater detail, tabs **414** can be used for proper positioning and supporting container assembly **16**A within container station **14**A. Fluid lines **416** are shown connected to ports **30** at upper end **22** and can also be used in container assembly **16**. It is appreciated that container assembly **16**A can have the same components, be made of the same materials, have the same sizes and shapes, and have all other alternatives as previously discussed above with regard to container assembly **16**. However, because container assembly **16** is commonly used for transporting fluids, container assembly **16**A typically has a volume in a range between about **10** liters to about **250** liters with about **25** liters to about **150** liters being more common. Other volumes can also be used.

Turning to FIG. **18**, container stations **14**A generally comprises a shipping vessel **420** removably mounted on a cart **422**. Cart **422** comprises a platform **424** having a top surface **426** and an opposing bottom surface **428**. In the depicted embodiment, platform **424** has a substantially square configuration. In alternative embodiments, however, platform **424** can be triangular, rectangular, circular, or of other polygonal or irregular configurations. Downwardly projecting from bottom surface **428** are a plurality of space apart wheels **430** which can be pivotally mounted to platform **424**. Also downwardly projecting from bottom surface **428** or otherwise attached to platform **424** is locking catch **200** which was previously discussed with regard to FIG. **6**. Locking catch **200** is mounted to cart **422** so that cart **422** can couple with docking station **12** in the same way that container station **14** can couple with docking station **12** as previously discussed with regard to FIGS. **7** and **8**.

As depicted in FIG. **19**, cart **422** further comprises a support base **432** and a plurality of spaced apart legs **434** that extend between platform **424** and support base **432**. In the embodiment depicted, support base **432** is shown as comprising a pair of crossed beams **433**A and B but in alternative embodiments can comprise a plate or any other structure that can support shipping vessel **420**. Mounted on and encircling support base **432** is an annular retaining wall **436**. Retaining wall **436** has an inside face **437** that extends from a bottom edge **439** to an opposing top edge **441**. A recess **443** is formed on top edge **441**. Inside face **437** bounds a cavity **438** extending above support base **432** into which shipping vessel **420** is received. Retaining wall **436** thus helps to prevent shipping vessel **420** from laterally sliding off of support base **432**. In alternative embodiments, it is appreciated that retaining wall **436** need not comprise a continuous encircling structure but can comprise a plurality of spaced apart posts or spaced apart sections of the depicted retaining wall **436**. In yet another alternative, retaining wall **436** can have a substantially C-shaped configuration.

Turning to FIG. **20**, cart **422** further comprises a pair of foldable handles **440**A and **440**B. Handle **440**A comprises a first handle portion **442** having a substantially L-shape configuration that extends out from one of legs **434** and terminates at a vertical riser **444**. Vertical riser has an inverted T-shaped slot **456** that extends down from a top edge thereof. Handle **440**A also comprises a second handle portion **448** that includes a post **450** slidably received within vertical riser **444**, an extension arm **452** orthogonally projecting from post **450**, and a hand grip **454** orthogonally projecting from extension arm **452**. A pin **446** radially outwardly projects from post **450** and is slid down the vertical section of slot **456** so as to be received within the horizontal section of slot **456**. Slot **456** forms a path along which pin **446** can travel so that second handle portion **448** can rotate laterally over a defined distance or be removed from fist handle portion **442** so that second handle portion **448** is not obstructive. Handle **440**B has the same configuration as handle **440**A and thus functions in a similar manner.

As also shown in FIG. **20**, shipping vessel **420** comprises an annular side wall **470** having an interior surface **472** and an opposing exterior surface **474** that longitudinally extend between an upper end **476** and opposing lower end **478**. Interior surface **472** bounds a chamber **480**. An annular lip **482** formed at upper end **476** bounds an access opening to chamber **480**.

Turning to FIG. **21**, although not required, in one embodiment, a base floor **484** is formed at bottom end **474** of side wall **470**. In one embodiment, base floor **484** and side wall **470** combine to form a barrel having a cylindrical configuration. However, in alternative embodiments, side wall **470** need to be cylindrical but can have a square, polygonal, irregular, or any other desired cross sectional configuration. An access port **490** extends through side wall **470** at lower end **478**. An annular sleeve **492** is disposed on side wall **470**, such as by adhesive, thermal welding, integral molding, or the like, and projects into chamber **480**. Sleeve **492** has an interior surface **494** which can be threaded. In turn, a plug **496** can have a threaded surface **498** such that plug **496** can be threaded into sleeve **492** for selectively closing access port **490**. A polygonal post **499** or corresponding socket can be formed on plug **496** to enable plug **496** to be rotated by a tool. In alternative embodiments, plug **496** can be secured within access port **490** through a friction connection, bayonet connection, or any other type of conventional removable connection.

Positioned within chamber **480** is a floor insert **500**. Floor insert **500** comprises an annular support wall **502** extending from a first end **504** to an opposing second end **506**. A recess **508** is formed on second end **506** of support wall **502**. Support wall **502** is configured to be freely passed down through chamber **480** until second end **506** rests on base floor **484** with sleeve **492** being received within recess **508**. Floor insert **500** further comprises a support floor **510** that has a substantially frustoconical configuration. More specifically, support floor **510** has an interior surface **512** and an opposing exterior surface **514** that slope downwardly and radially inward from a first end **516** connected to first end **504** of support wall **502** to an opposing second end **518**. Second end **518** bounds an annular opening **520**. A plurality of support braces **522** extend between support wall **502** and support floor **510**. As a result of support floor **510**, chamber **480** is divided into an upper chamber **524** that extends from annular lip **482** to support floor **510** and a lower chamber **526** that extends from support floor **510** to base floor **484**.

In one embodiment, floor insert **500** is removably positioned within chamber **480** so that it is supported on base floor **484**. In an alternative embodiment, floor insert **500** can be secured within chamber **480** such as by welding, adhesive, or mechanical connection. In yet other alternative embodiments, support wall **502** can be eliminated and support floor **510** can be welded or otherwise secured directly to interior surface **472** of side wall **470**. Another alternative design for shipping vessel **420** is disclosed in U.S. Pat. No. 7,153,021, which is incorporated herein by specific reference. Shipping vessel **420** is typically comprised of plastic but can be made of metal, composite, or other desired materials.

Returning back to FIG. **20**, a retention ring **540** is used for securing container assembly **16**A within upper chamber **524** of shipping vessel **420**. Retention ring **540** comprises a substantially C-shaped ring body **542** that terminates at opposing ends having flanges **544**A and **544**B formed thereat. A fastener **546** extends through flanges **544**A and B and can be used for selectively drawing and securing flanges **544**A and B together. In one embodiment, fastener **546** can comprise a blot and nut assembly. In alternative embodiments, fastener **546** can comprise a clamp, latch, or any other conventional fastener that achieve the desired objective.

Ring body **542** is typically in the form of a narrow band having an inside face **548** and an opposing outside face **550**. A plurality of spaced apart catches **552** are mounted on inside face **548** of ring body **542**. In one embodiment, each catch **552** comprises a elongated pin having a first end **554** that is secured, such as by welding, at a central location on inside face **548**. Each pin also comprises an opposing second end **556** that projects up above ring body **540**. If desired, second end **556** of each pin can be rounded. Although not required, in one embodiment a plurality of spaced apart notches **558** are recessed on the bottom edge of ring body **542** such that the top of each notch **558** is disposed adjacent to first end **554** of a corresponding catch **552**.

During use, fastener **546** is loosened so as to expand the size of ring body **542**. Ring body **542** is then positioned on upper end **476** of shipping vessel **420** so that ring body **542** encircles exterior surface **474** of side wall **470**. In this configuration, first end **554** of each catch **552** rests on top of annular lip **482** of side wall **470** so that retention ring **540** is properly positioned. If desired, a flange can be formed at first end **554** of each catch **552** for receiving annular lip **482**. Notches **558** permit a visual inspection to ensure that ring body **542** is properly seated. Fastener **546** is then used to clamp retention ring **540** on side wall **470**. As container assembly **16**A (FIG. **17**) is inserted within upper chamber **524**, second end **556** of each catch **552** is passed through opening **415** of a corresponding alignment tab **414** so that container assembly **16**A is supported and suspended within upper chamber **542** as shown in FIG. **16**.

As shown in FIG. **22**, during use shipping vessel **420** is manually positioned on cart **422** so that lower end **478** is received within retaining wall **436**. Shipping vessel **420** is oriented so that access port **490** on shipping vessel **420** is aligned with recess **443** on retaining wall **436**. Either before or after removably positioning shipping vessel **420** on cart **422**, retention ring **540** is removably secured to upper end **476** of shipping vessel **420** as discussed above. An empty container assembly **16**A (FIG. **17**) is then position within upper chamber **524** of shipping vessel **420** so that catches **552** pass through openings **415** in alignment tabs **414** (FIG. **16**).

Plug **496** can then be removed and an operator can reach through access port **490** and guide drain line **412** (FIG. **17**) down through opening **520** of shipping vessel **420** (FIG. **21**) and into lower chamber **526** where drain line **412** is temporarily stored. Port **410** of container assembly **16**A (FIG. **17**) can also be pulled down and positioned at or adjacent to opening **520** of shipping vessel **420** so that container assembly **16**A is properly positioned within upper chamber **524** of shipping vessel **420**. If desired, plug **496** can be then reinserted. In alternative embodiments, it is appreciated that retention ring **540** is not required. In this embodiment, container assembly **16**A is unfolded and freely positioned within upper chamber **524** of shipping vessel **420**. As container assembly **16**A is filled with fluid, additional care must be taken to adjust container assembly **16**A so that it remains properly positioned and is not kinked or folded.

Next, cart **422** is coupled with docking station **12** as depicted in FIG. **16**. This is accomplished by locking catch **200** (FIG. **18**) on cart **422** coupling with locking assembly **244** (FIG. **7**) on docking station **12** in the same way that container assembly **14** couples with docking station **12** as previously discussed. It is appreciated that docking station **12** and/or cart **14** can be moved as part of this docking process. Once docking station **12** and cart **422** are securely coupled together, rotational assembly **48** (FIG. **17**) of container assembly **16**A is coupled with drive motor assembly **300** as previously discussed and shown in FIG. **16**. Depending on the size of container station **14**A, it may be necessary to adjust the vertical height or orientation of drive motor assembly **300** as previously discussed.

Next, drive shaft **362** (FIG. **3**) is advanced down through drive motor assembly **300** and into impeller assembly **40** as

also previously discussed. Depending on the size of Either prior to or after the insertion of drive shaft **362**, fluid is delivered into compartment **28** of container assembly **16**A through one of fluid lines **416** (FIG. **17**). Drive motor assembly **300** can then be activated to mix the components within container assembly **16**A. Once the desired processing is complete, drive shaft **362** can be removed and cart **422** separated from docking station **12**. Because container assembly **16**A now contains fluid and is fully supported by side wall **470** and support floor **510** of shipping vessel **420** (FIG. **21**), the retention ring **540** can be removed from shipping vessel **420** and container assembly **16**A. Fluid lines **416** can be coiled and placed on top of container **18** within upper chamber **524**. A lid **564**, as shown in FIG. **23**, can then be removably secured to upper end **476** of shipping vessel **420** so as to close off the opening thereof. If desired, lid **564** can be secured to shipping vessel **420** by fasteners, straps, clamps, or the like.

With lid **564** secured, shipping vessel **420** can be removed from cart **422**. Shipping vessel **420**, containing container assembly **16**A with fluid therein, is then often moved to a temporary storage room. Where the fluid is media or other fluid that should be refrigerated, the storage room can be a cold room. When needed, shipping vessel **420** can be shipped, such as through a truck, train, airplane, ship or the like, to a customer, related facility, end user, or any other desired destination. Again, where needed, the shipping vehicle can have a refrigerated compartment for carrying shipping vessel **420**. In alternative embodiments, it is appreciated that shipping vessel **420** can remain on cart **422** and the entirely assembly can be stored and/or shipped. Once shipping vessel **420** reaches the desired destination, it is then placed on a second cart **422** located at the destination which second cart **422** is then coupled with a second docking station **12** located at the destination. Either before or after coupling with second docking station **12**, lid **564** is removed. Rotational assembly **48** is then coupled with drive motor assembly **300** and drive shaft **362** is coupled therewith as previously discussed with regard to FIG. **16**. If needed, the height or orientation of drive motor assembly **300** can be adjusted. Drive motor assembly **300** can then be activated to mix or resuspend fluids contained with container assembly **16**A. Further processing of the fluid within container assembly **16**A, such as adding additional components, can then also occur. Either while coupled with the second docking station **12** or after being removed therefrom, plug **496** can be removed and drain line **412** (FIG. **17**) passed out through access port **490** (FIG. **21**) and coupled with a further container or fluid line for transferring the fluid out of container assembly **16**A. Once the fluid has been used, the container assembly **16**A can be disposed of and shipping vessel **420** returned to the original location for reuse with a new container assembly **16**A.

It is appreciated that the inventive system provides a modular system wherein standardized components, such as docking station **12** and cart **422**, can be located at a number of different locations. Shipping vessel **420** can then be easily transported between the different locations and the fluid therein mixed or resuspended along with other processing without having to transfer the fluid to different containers. This helps to ensure sterility while minimizing costs and effort in performing the desired processing. The inventive system and method also permits reuse of shipping vessel **420** and disposal of container assembly **16** without the requirement for any washing or sterilization.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

**1**. A method for shipping a fluid, the method comprising:

removably securing a retention ring to a shipping vessel that bounds a chamber, the retention ring having a plurality of catches disposed thereon;

inserting a collapsible bag within the chamber of the shipping vessel so that a plurality of alignment tabs secured to the collapsible bag are removably secured to corresponding catches of the retention ring;

dispensing a fluid into a compartment of the collapsible bag, the shipping vessel being removably positioned on a movable first cart such that a lower end of the shipping vessel is supported on the first cart;

coupling the first cart directly to a first docking station, the first docking station comprising a stand and a first drive motor assembly mounted thereon;

mixing the fluid within the compartment of the collapsible bag by using the first drive motor assembly to rotate a drive shaft extending between the first drive motor assembly and the collapsible bag, the drive shaft passing into the chamber of the shipping vessel through an opening formed at an upper end of the shipping vessel, the upper end of the shipping vessel being disposed above the lower end of the shipping vessel;

separating the first cart from the first docking station;

removing the shipping vessel containing the collapsible bag and fluid from the first cart;

shipping the shipping vessel removed from the first cart and containing the collapsible bag and fluid to a second location;

positioning the shipping vessel on a movable second cart;

coupling the second cart to a second docking station, the second docking station comprising a stand and a second drive motor assembly mounted thereon; and

mixing the fluid within the compartment of the collapsible bag by using the second drive motor assembly to rotate a drive shaft extending between the second drive motor assembly and the collapsible bag.

**2**. The method as recited in claim **1**, wherein the shipping vessel comprises a plastic barrel.

**3**. The method as recited in claim **1**, where in the fluid comprises a media, buffer or reagent.

**4**. The method as recited in claim **1**, further comprising securing a lid to the shipping vessel prior to shipping the shipping vessel, the lid being completely removable from the shipping vessel.

**5**. The method as recited in claim **1**, wherein the step of mixing the fluid comprises:

advancing the drive shaft consecutively through a portion of the first drive motor assembly, through a hub rotatably mounted on the collapsible bag, and into an elongated tubular connector, the tubular connector having the hub mounted on a first end and an impeller mounted on an opposing second end; and

activating the first drive motor assembly so that the first drive motor assembly rotates the drive shaft which in turn rotates the impeller within the compartment of the collapsible bag.

**6**. The method as recited in claim **1**, further comprising removing the retention ring from the shipping vessel prior to shipping the shipping vessel to the second location.

**7**. A fluid mixing system comprising:

(i) a cart comprising:

a frame;
a plurality of wheels mounted to frame; and
a locking catch coupled to the frame;
(ii) a shipping vessel removably positioned on the frame of the cart such that a lower end of the shipping vessel is supported on the cart, the shipping vessel comprising:
an encircling sidewall bounding a chamber and extending between an upper end and an opposing lower end;
a support floor disposed within the chamber and dividing the chamber into an upper compartment and a lower compartment;
an opening extending through the support floor so as to provide communication between the upper compartment and the lower compartment; and
an access port extending through the sidewall at the lower end thereof so as to communicate with the lower compartment;
(iii) a container assembly comprising:
a collapsible bag bounding a compartment, the collapsible bag being at least partially disposed within the upper compartment of the chamber of the shipping vessel;
(iv) a docking station comprising:
a stand;
a locking assembly secured to the stand, the locking assembly engaging the locking catch of the cart so that the cart is releasably secured to the docking station; and
a drive motor assembly mounted to the stand; and
(v) an elongated drive shaft removably coupled with the drive motor assembly and removably coupled with a mixing element located within the compartment of the collapsible bag, the drive shaft passing into the chamber of the shipping vessel through an opening formed at an upper end of the shipping vessel, the upper end of the shipping vessel being disposed above the lower end of the shipping vessel, the drive motor assembly being configured to rotate the drive shaft.

**8**. The fluid mixing system as recited in claim **7**, wherein the container assembly further comprises:
a rotational assembly comprising a casing mounted to the collapsible bag and a hub rotatably mounted to the casing, the hub having a passageway extending therethrough;
the mixing element comprising an impeller; and
an elongated tubular connector extending between the hub and impeller, the drive shaft passing consecutively through the hub and into the tubular connector.

**9**. The fluid mixing system as recited in claim **7**, wherein the cart further comprises:
a plurality of legs upstanding from the frame; and
a support secured to the legs, the shipping vessel resting on the support.

**10**. The fluid mixing system as recited in claim **7**, wherein the shipping vessel comprises a plastic barrel.

**11**. The fluid mixing system as recited in claim **7**, further comprising a retention ring removably secured to the shipping vessel, the collapsible bag being removably secured to the retention ring.

**12**. The fluid mixing system as recited in claim **7**, further comprising a base floor disposed at the lower end of the sidewall so that the lower compartment is bounded between the support floor and the base floor.

**13**. The fluid mixing system as recited in claim **7**, further comprising a drain line extending from the collapsible bag, the drain line or collapsible bag passing through the opening on the support floor, the drain line passing through the access port.

**14**. The method for shipping a fluid as recited in claim **1**, wherein the drive shaft extending from the first drive motor engages an impeller disposed within the collapsible bag.

**15**. The method for shipping a fluid as recited in claim **1**, wherein the step of mixing the fluid within the compartment of the collapsible bag by using the first drive motor assembly includes the drive shaft passing into the chamber of the shipping vessel through an opening formed at an upper end of the shipping vessel.

**16**. The method for shipping a fluid as recited in claim **1**, wherein the step of mixing the fluid within the compartment of the collapsible bag by using the first drive motor assembly includes removably coupling the draft shaft to the first drive motor and removably coupling the draft shaft to a mixing element located within the compartment of the collapsible bag.

**17**. The method for shipping a fluid as recited in claim **1**, wherein the shipping vessel comprises:
an encircling sidewall bounding the chamber and extending between an upper end and an opposing lower end;
a support floor disposed within the chamber and dividing the chamber into an upper compartment and a lower compartment, the collapsible bag being at least partially disposed within the upper compartment;
an opening extending through the support floor so as to provide communication between the upper compartment and the lower compartment;
a base floor disposed at the lower end of the sidewall so that the lower compartment is bounded between the support floor and the base floor; and
an access port extending through the sidewall at the lower end thereof so as to communicate with the lower compartment.

**18**. A method for shipping a fluid, the method comprising:
removably securing a retention ring to a shipping vessel that bounds a chamber, the retention ring having a plurality of catches disposed thereon;
inserting the collapsible bag within the chamber of a shipping vessel so a plurality of alignment tabs secured to the collapsible bag are removably secured to corresponding catches of the retention ring;
dispensing a fluid into a compartment of the collapsible bag, the shipping vessel being removably positioned on a movable first cart;
coupling the first cart directly to a first docking station, the first docking station comprising a stand and a first drive motor assembly mounted thereon;
mixing the fluid within the compartment of the collapsible bag by using the first drive motor assembly to rotate a drive shaft extending between the first drive motor assembly and the collapsible bag;
separating the first cart from the first docking station;
removing the shipping vessel containing the collapsible bag and fluid from the first cart;
shipping the shipping vessel removed from the first cart and containing the collapsible bag and fluid to a second location;
removing the retention ring from the shipping vessel prior to shipping the shipping vessel to the second location; and
mixing the fluid within the compartment of the collapsible bag in the shipping vessel at the second location.

19. The method for shipping a fluid as recited in claim 18, wherein the step of mixing the fluid at the second location comprises:

positioning the shipping vessel on a movable second cart;

coupling the second cart to a second docking station, the second docking station comprising a stand and a second drive motor assembly mounted thereon; and

mixing the fluid within the compartment of the collapsible bag by using the second drive motor assembly to rotate a drive shaft extending between the second drive motor assembly and the collapsible bag.

20. A method for shipping a fluid, the method comprising:

dispensing a fluid into a compartment of a collapsible bag, the collapsible bag being positioned within a chamber of a shipping vessel, the shipping vessel being removable positioned on a movable first cart, the shipping vessel comprising:

an encircling sidewall bounding the chamber and extending between an upper end and an opposing lower end;

a support floor disposed within the chamber and dividing the chamber into an upper compartment and a lower compartment, the collapsible bag being at least partially disposed within the upper compartment;

an opening extending through the support floor so as to provide communication between the upper compartment and the lower compartment; and

an access port extending through the sidewall at the lower end thereof so as to communicate with the lower compartment;

coupling the first cart directly to a first docking station, the first docking station comprising a stand and a first drive motor assembly mounted thereon;

mixing the fluid within the compartment of the collapsible bag by using the first drive motor assembly to rotate a drive shaft extending between the first drive motor assembly and the collapsible bag;

separating the first cart from the first docking station;

removing the shipping vessel containing the collapsible bag and fluid from the first cart;

shipping the shipping vessel removed from the first cart and containing the collapsible bag and fluid to a second location;

mixing the fluid within the compartment of the collapsible bag in the shipping vessel at the second location.

21. A fluid mixing system comprising:

(i) a cart comprising:

a frame;

a plurality of wheels mounted to frame; and

a locking catch coupled to the frame;

(ii) a shipping vessel removably positioned on the frame of the cart, the shipping vessel comprising:

an encircling sidewall bounding the chamber and extending between an upper end and an opposing lower end;

a support floor disposed within the chamber and dividing the chamber into an upper compartment and a lower compartment;

an opening extending through the support floor so as to provide communication between the upper compartment and the lower compartment; and

an access port extending through the sidewall at the lower end thereof so as to communicate with the lower compartment;

(iii) a container assembly comprising:

a collapsible bag bounding a compartment, the collapsible bag being at least partially disposed within the upper compartment of the chamber of the shipping vessel;

(iv) a docking station comprising:

a stand;

a locking assembly secured to the stand, the locking assembly engaging the locking catch of the cart so that the cart is releasably secured to the docking station; and

a drive motor assembly mounted to the stand; and

(v) an elongated drive shaft removably coupled with the drive motor assembly and removably coupled with a mixing element located within the compartment of the collapsible bag, the drive shaft passing into the chamber of the shipping vessel through an opening formed at an upper end of the shipping vessel, the drive motor assembly being configured to rotate the drive shaft.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

# CERTIFICATE OF CORRECTION



PATENT NO. : 9,314,751 B2
APPLICATION NO. : 12/986701
DATED : April 19, 2016
INVENTOR(S) : Goodwin et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Drawings

Sheet 1, replace Fig. 1 as shown on the attached sheet, where reference number "107" has been added

Sheet 7, Fig. 7, replace reference number "226A" with --266A--

Sheet 20, replace Fig. 20 as shown on the attached sheet, wherein reference number "546" has been added

In the Specification

Column 1
Line 42, change "dispending the fluid" to --dispensing the fluid--
Line 55, change "minimize in risk" to --minimize the risk--

Column 2
Line 14, change "partially disassembly" to --partially disassembled--

Column 3
Line 2, change "and/or where is solution" to --and/or where the solution--

Column 4
Line 11, change "container 18 comprise" to --container 18 comprises--

Column 5
Line 27, change "material that bound" to --material that bounds--

Column 6
Line 28, change "to tubular connect 42" to --to tubular connector 42--

Signed and Sealed this
Twenty-fourth Day of October, 2017

Joseph Matal

Joseph Matal
*Performing the Functions and Duties of the*
*Under Secretary of Commerce for Intellectual Property and*
*Director of the United States Patent and Trademark Office*

Column 7
Line 39, change “different configuration” to --different configurations--

Column 8
Line 16, change “will be couple” to --will be coupled--

Column 9
Line 32, change “tubes extends” to --tubes extending--
Line 55, change “different configuration” to --different configurations--
Line 62, change “observation slot 176” to --observation slots 176--
Line 64, change “permit and easy verification” to --permit easy verification--

Column 10
Line 65, change “rod 21 OB” to --rod 210B--

Column 11
Line 5, change “226B” to --266B--
Lines 16-17, change “runner 226A and 226B” to --runners 266A and 266B--

Column 12
Line 66, change “By pulling 326 out pin 326” to --By pulling out pin 326--

Column 13
Line 44, change “plane and or in” to --plane and/or in--

Column 14
Line 57, change “can then be couple” to --can then be coupled--

Column 15
Line 58, change “and supporting container” to --and supporting of container--

Column 16
Line 4, change “container stations” to --container station--
Line 12, change “plurality of space apart” to --plurality of spaced apart--

Column 17
Line 6, change “need to be” to --need not be--
Line 60, change “blot and nut” to --bolt and nut--
Line 67, change “comprises a elongated” to --comprises an elongated--

Column 18
Line 33, change “is then position” to --is then positioned--

Column 19
Line 29, change “the entirely assembly” to --the entire assembly--

In the Claims

Column 23
Line 15, change “being removable” to --being removably--

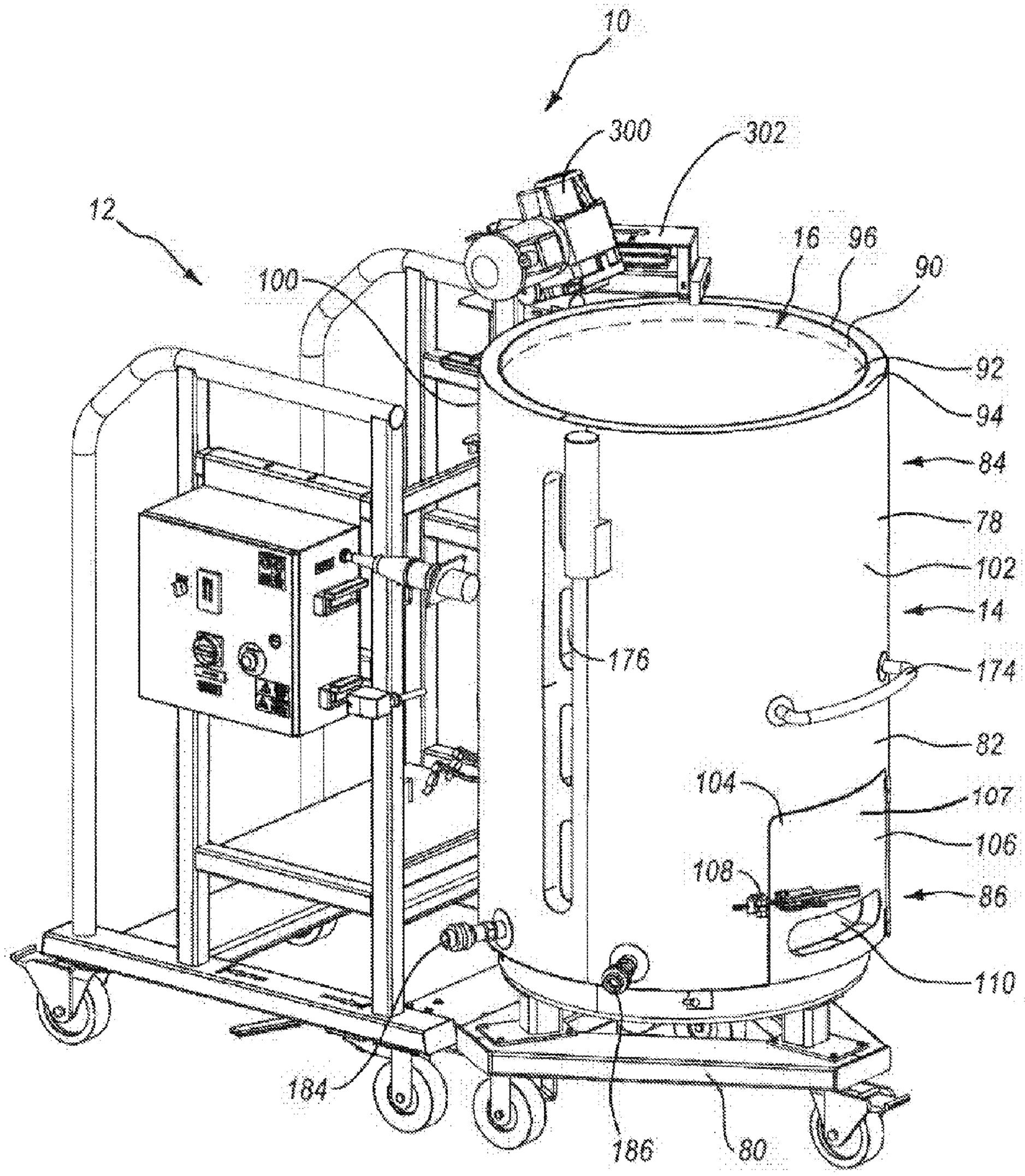
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Fig. 1

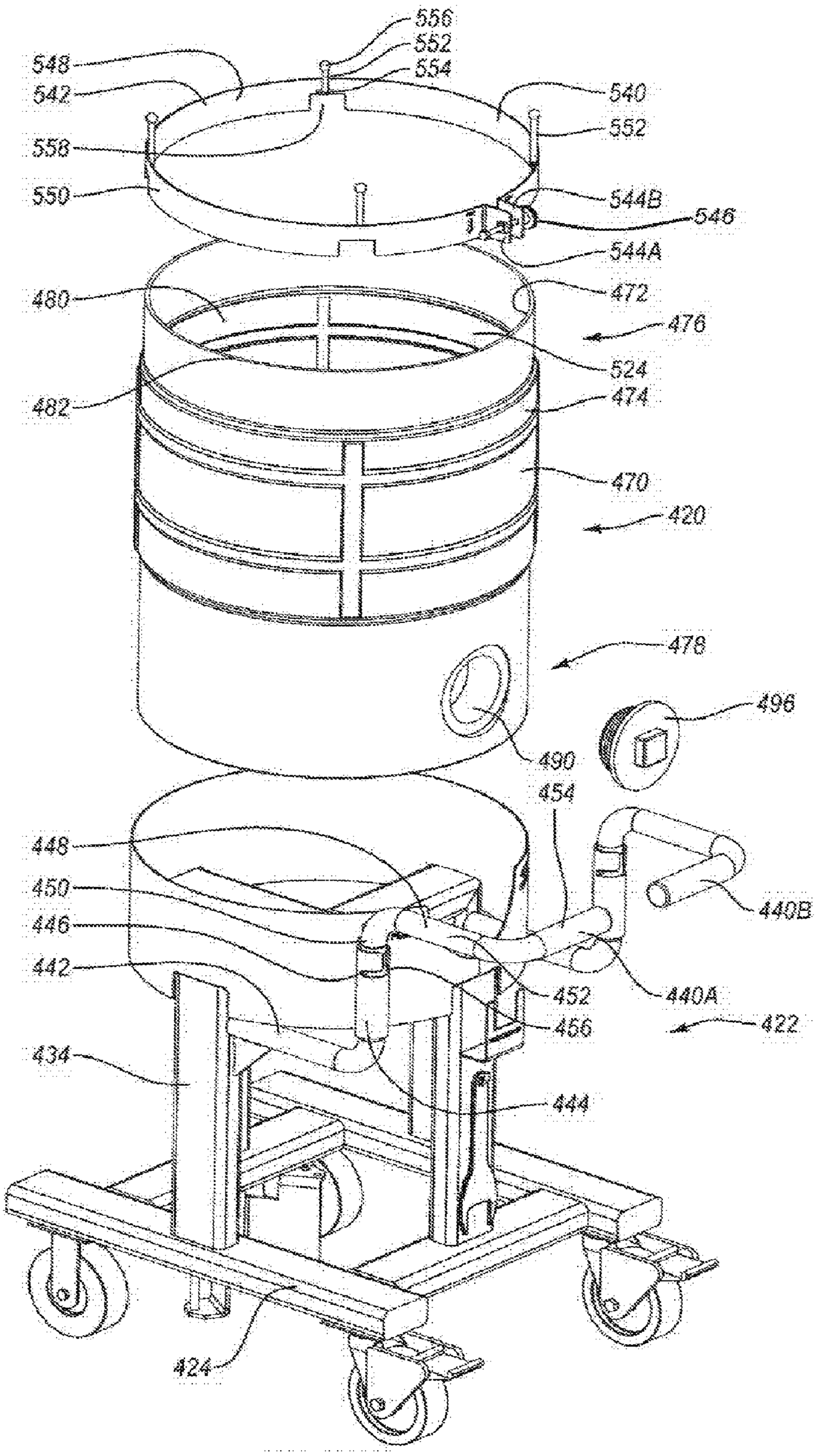
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Fig. 20